HIGH VOLTAGE PORCELAIN INSULATORS: IMPORT COMPETITION

A Report for the
High Voltage Insulator Section
National Electrical Manufacturers Association

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I. INTRODUCTION AND SUMMARY

In 1964 the U. S. market for high voltage porcelain insulators began to expand rapidly. By year-end 1967, U. S. manufacturers' sales had grown to \$77.8 million from \$46.8 million in 1964. This rapid rise was a welcome relief to an industry which had been on a sales plateau for a decade. The boom in sales, however, also provided foreign manufacturers with an unparalleled opportunity to penetrate the U. S. market. Sales of foreign insulators grew (on a duty paid, c.i.f. basis) from \$2.8 million in 1964 to \$20.7 million in 1967. At year-end 1967, they commanded 21 percent of the U. S. market.

U. S. manufacturers, concerned about even more intense import competition in the event of a slowdown in demand, wanted to be sure that past advances by imports were not in violation of U. S. laws. They retained Horace J. De Podwin Associates, Inc., 350 Fifth Avenue, New York, N. Y. 10001, to study the Japanese high voltage porcelain industry to determine whether sales to the U. S. have been at fair values.

The investigation was conducted both in the U. S. and in Japan. Discussions were held with American manufacturers to obtain background information on the industry and its products, and to identify the areas of specific concern. Information was also obtained through interviews with the principal U. S. importers of porcelain insulators, NGK Insulators of America. Finally, visits were made to two federal power agencies, the Tennessee Valley Authority (TVA) and the Bonneville Power Administration (BPA), to collect descriptions of their purchases of insulators.

The investigations in Japan included a visit to the two principal manufacturers to collect data on Japanese methods and costs of production. The visits included plant tours. Price information and details of market conditions were obtained by visiting the major Japanese purchasers of high voltage insulators and also by conducting an exhaustive library search of all Japanese trade publications dealing with insulators.

The most important findings of the report are these:

- Japanese producers have enjoyed rapid, steady growth in sales. The rate of increase from 1956-57 to 1966 was over 12 percent per year.

- All of this growth has been achieved through exports. Japanese domestic sales had no growth between 1959-1961 to 1964-1966, compared to a 181 percent increase in exports. Exports now account for 56 percent of total sales.

- In the past three years it has been the U. S. market that permitted this growth. At year-end 1967 the U. S. was receiving 55 percent of Japanese exports.

- The principal Japanese supplier, NGK, has established a permanent sales and marketing organization in the U. S. aimed at selling to investor-owned public utilities.

- U. S. imports have changed since 1963 both by customer and by type of insulator purchased. Federal power agencies are still among Japan's most important customers.

- NGK bids to TVA and BPA have been consistently below U. S. manufacturers' bids — by as much as 50 percent. But other foreign manufacturers' bids can be close to NGK's. Italian and French producers must meet the price levels set by NGK if they are to secure orders.

- NGK dominates the Japanese industry. It accounts for 80 percent of Japanese production and virtually all exports to the U. S.

- Analyses of NGK production processes reveal a highly capitalized modern operation of good efficiency. The company also has a substantial research program.

- Analyses of NGK costs of production, based on raw material prices and labor costs, indicate that NGK is pricing 25,000 pound suspension insulators (as well as other types of insulators) in the U. S.

market lower than sales of similar insulators in Japan. The differential for suspension insulators was calculated at about 19 percent. This differential was confirmed by home market prices obtained from independent sources in Japan.

If NGK were required to price fairly in the U. S. — at Japanese price levels — their prices would rise by almost 15 percent. Foreign bids to U. S. public power agencies must be from 6 to 12 percent lower than bids by U. S. producers, depending on the size and location of U. S. companies.[1] A review of TVA and Bonneville suspension insulator contracts awarded NGK in the past year revealed that a 15 percent increase in NGK's bids plus the minimum 6 percent differential would have been sufficient to switch awards from NGK to American producers — in those cases where other foreign producers had not bid.

Alternatively, NGK could simultaneously reduce Japanese prices and raise U. S. prices to redistribute their earnings but maintain their current level of operating profits. In this case, NGK prices to the U. S. would rise over 7 percent. Depending on the amount of differential considered in awarding contracts, American producers' bids would be very competitive.

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[1] Buy American Act and Executive Order 10582, 19 Federal Register 8723 (1954). The usual Buy American differential is 6 percent. It becomes 12 percent when the place of manufacture is an unemployment area, so designated by the U. S. Secretary of Labor. It may also become 12 percent if the domestic bid is submitted by a manufacturer qualifying as a small business.

STATISTICAL APPENDIXES

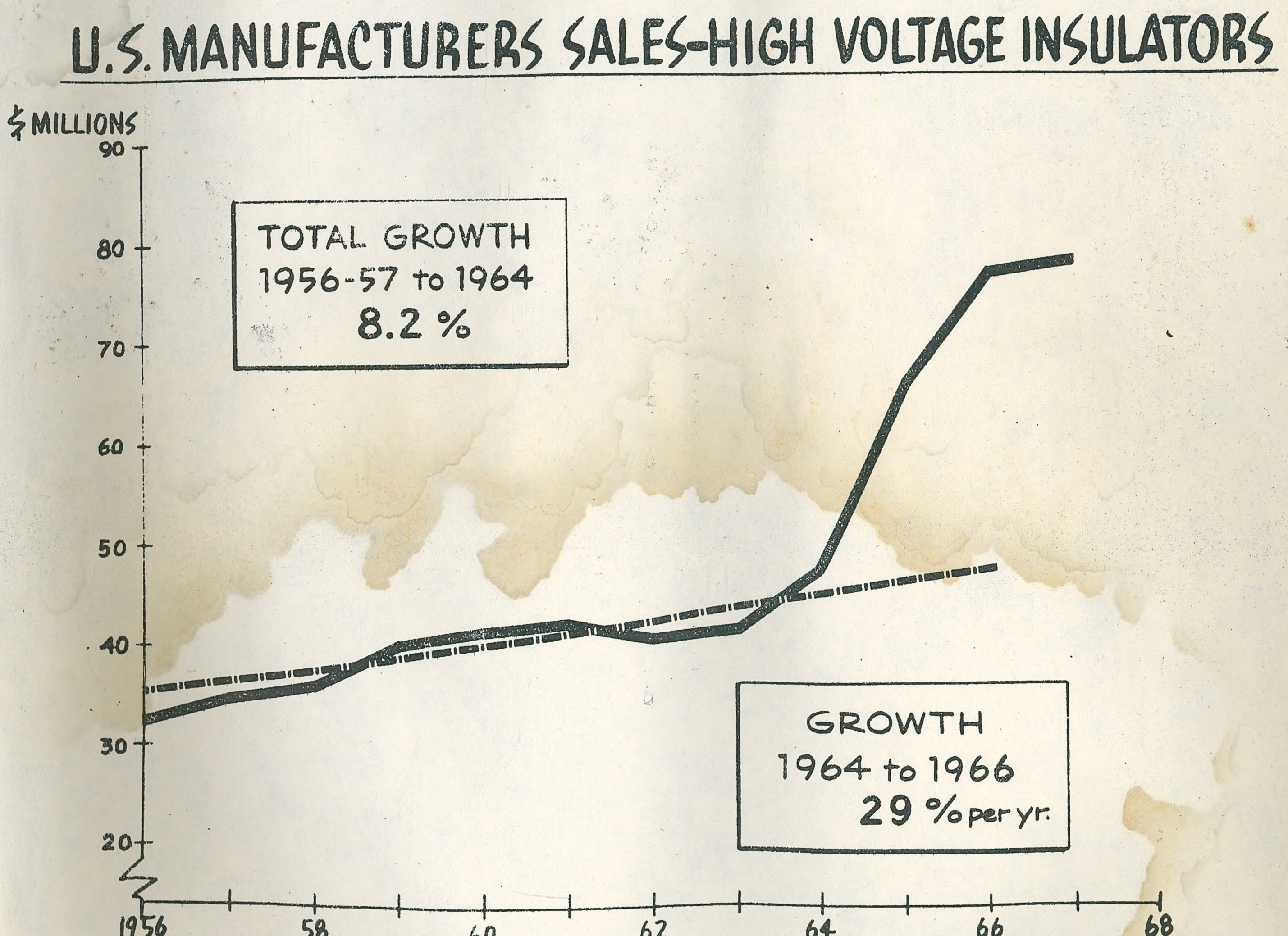
A substantial body of statistical information was collected in the preparation of this report. Some of this information was summarized and is presented with the text of the report. Most of the data collected, however, are presented in four Statistical Appendixes following the report. The first appendix contains information on United States manufacturers' sales and imports. There is also a discussion of statistical problems arising from the improper classification of imported insulators by the U. S. Bureau of Customs. Japanese industry data are presented in the second appendix and include tables on the importance of exports to total Japanese sales and of the increased reliance of the Japanese on the U. S. The third appendix presents extensive information on the operations of NGK Insulators, Ltd. The data include tables on cost of production and corporate profits. The statistics on NGK raw materials and labor were used in calculating NGK unit costs of producing suspension insulators and thus formed one base of the finding that NGK is apparently following a policy of differential pricing between home and export market sales.

Finally, there is a separate volume of tables recording the bids and awards on all the high voltage insulator contracts awarded during the last five years by the Tennessee Valley Authority and the Bonneville Power Administration. The awards by TVA for suspension insulators were analyzed to determine the per unit FOB price. Individual costs of entry, such as ocean freight, inland freight, and customs duties, were also calculated on a per unit basis and are included in this section of the appendix.

II. THE UNITED STATES MARKET FOR HIGH VOLTAGE PORCELAIN INSULATORS

U. S. MANUFACTURERS' SALES

For nine years, between 1956 and 1964, U. S. manufacturers' sales of high voltage porcelain insulators were on a plateau. In fact, growth from the base 1956-1957 to 1964 was only 8.2 percent, or just 1.1 percent per year.



Abruptly, in 1964, U. S. demand for insulators rose sharply and U. S. producers' sales increased from $46.8 million at year-end 1964 to $76.5 million in 1966, or 29 percent per year.

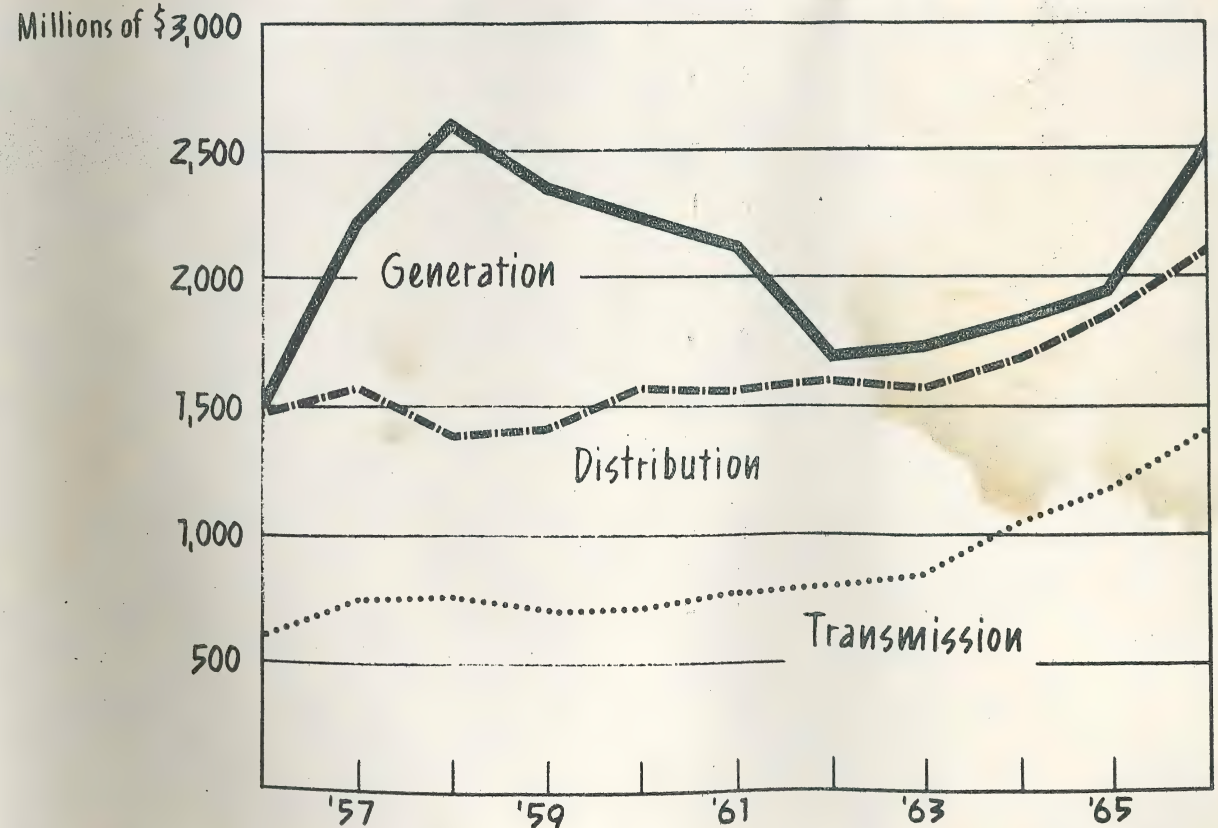
The growth in U. S. demand continued through 1967 but at a slower rate. Although industry sales set another record at $77.8 million, new orders slowed. The outlook for 1968 is for sales at or below the 1967 peak.

Insulator sales are closely related to electric utility spending. Lagging sales from 1956-1964 can be explained by the pattern of capital expenditures of electric utilities. After rapid growth between 1956-1957, electric utility spending reached a peak in 1958. From 1958 to 1963, utilities deferred their capital investments, and insulator sales were stagnant. In 1965, electric utility investment rose by 10 percent. Spending increased another 17 percent in 1966, and insulator sales followed. This continued through 1967, another year of high electric utility investment. Insulator sales followed suit.

This rapid growth in electric utility spending provided a welcome relief to U. S. insulator manufacturers, but also provided foreign manufacturers with an unparalleled opportunity to penetrate the U. S. market for high voltage insulators. Indeed, it is in times of peak demand that imports find it easiest to penetrate markets — not when market conditions are soft. Between 1964 and 1967, imports (valued on a c. i. f. basis) rose from about 6 to 21 percent of the U. S. market.

The rapid market growth also gave rise to an ambitious program by U. S. manufacturers to expand production capacity to meet utility system demands. For example, Lapp Insulator Company and Ohio Brass Company each began work on new plants. General Electric made significant changes in its kiln capacity.

ELECTRIC UTILITY SPENDING FOR GENERATION, TRANSMISSION & DISTRIBUTION SYSTEMS



SOURCE: ELECTRICAL WORLD, "1966 ANNUAL STATISTICAL REPORT," JAN. 24, 1966, McGRAW-HILL, INC.

Projections of utility spending indicate a leveling off at 1967 levels. If so, a real possibility exists that the U. S. producers' newly added capacity will not be fully utilized and a market condition similar to that of the late 1950's may be recreated. Excess capacity may lead to a new slump, and demand for "from the shelf" spot deliveries and lower prices will appear. The pressure of substantial imports makes this possibility even greater. The major importer, NGK Insulators, Ltd. (NGK) of Japan, has been building a substantial sales organization in the U. S. designed to prove to utilities, public and private, that they are keenly interested in providing continuous service rather than spot sales. Thus, NGK will seek to maintain its volume, even if the market shrinks. This will help determine the amounts U. S. producers can sell. The major advantage of imports is price, while the major disadvantage is delivery time. As delivery times get shorter, foreign producers will need to offer lower prices to utilities to offset any inconvenience from longer delivery times — in competition with U. S. producers offering high voltage porcelain off the shelf.

U. S. IMPORTS

Imports of high voltage porcelain began to penetrate United States markets in appreciable volume during 1962, increasing sharply to $600, 000 (valued FOB) from $100, 000 (valued FOB) a year earlier. From 1962, imports, especially from Japan, increased rapidly, and at year-end 1964, imports totaled $1. 8 million (valued FOB), accounting for 4 percent of the U. S. market. Virtually all (96. 7 percent) of the imports in 1964 were from Japan.

The first large sales of imported insulators were to U. S. public power agencies. For example, Japanese insulators were purchased by the Bonneville Power Authority in 1953. This sale was followed by a large order from the Tennessee Valley Authority in 1957 and then one from the Bureau of Reclamation in 1958. Until 1964, imports were not too successful in penetrating the investor-owned utility markets.

In 1964, with American firms operating close to capacity, foreign manufacturers seized the opportunity to extend their foothold in the United States and sold aggressively. According to U. S. government statistics, imports more than doubled in 1965 and continued to rise to $13.8 million (valued FOB) in 1967. This rate of increase was faster than the rapid rate at which the U. S. market was expanding, and, by year-end 1967, imports represented about 14 percent of the U. S. market, up from about a four percent share three years earlier.

Since imports are measured on an FOB basis, their share of the U. S. market is significantly understated by the official statistics. (A description of the U. S. Bureau of Customs tariff classifications is included in the Appendix.) For example, a 25,000 pound suspension insulator selling at $1.64, FOB Nagoya, sold for $2.52 delivered to TVA in early 1966 — a difference of 53.6 percent. Assuming a 50 percent differential on all import sales, the actual value of the $13.8 million of FOB valued imports in 1967 was $20.7 million. When

imports are added to U. S. manufacturers' domestic sales of $77.8 million, the total U. S. market was approximately $98.5 million in 1967. Therefore, on a full value basis, imports accounted for about 21 percent of the U. S. market. Again, most of the imports — 82.0 percent — were from Japan and almost all of these from one company, NGK of Japan. This one company, then, accounts for about 17 percent of the entire U. S. market.

U. S. IMPORTS OF HIGH VOLTAGE PORCELAIN INSULATORS *
All Countries and Japan, 1963-1967

	Total Imports	Imports from Japan	Japan's Share of Imports	Japan's Share of U. S. Market
1963	$2,066,000 **	$1,916,000 **	89.1%	4.4%
1964	2,765,000	2,675,000	96.7	5.4
1965	6,501,000	6,231,000	95.8	8.6
1966	20,448,000	18,023,000	88.1	18.6
1967	20,723,000	16,986,000	82.0	17.2

* Imports are adjusted to include costs of entry. Market size equals sum of U. S. manufacturers' sales plus adjusted value of imports.

** Annualized total: based on last four months of 1963.

Source: The U. S. Bureau of the Census.

According to officials at NGK Insulators, the principal Japanese supplier, most (75 percent) of their sales in the U. S. were of suspension insulators. The proportion of U. S. producers' sales of suspension insulators to their total sales is much smaller. Consequently, Japanese penetration of the U. S. suspension insulator market is even higher than their penetration of the whole market. In 1967, for example, Japanese imports of suspension insulators were estimated at $12.8 million (valued as sold in the U. S.). U. S. producers' sales of suspensions were $23.2 million,[1] for a total U. S. suspension insulator market of $36.0 million. Thus, Japan's 1967 share of the suspension insulator market was 35.5 percent compared to a 17.2 percent penetration of the total market.

Surprisingly, the growth in insulator imports seems to have stopped abruptly. Imports in 1967 were about $20.7 million (valued as sold in U. S.), barely above 1966 imports. American manufacturers' sales were $77.8 million in 1967, up slightly from $76.5 million in 1966. Thus, imports maintained their 21 percent share of the U. S. market. This slowing in imports reflects the softening of demand which American producers are also experiencing.

Imports from Japan actually fell during 1967 to $17.0 million (valued as sold in the U. S.). This was about six percent below their 1966 record of $18.0 million (valued as sold in the U. S.). As imports from other countries, especially France and Italy, continued to increase, Japan's share of total

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[1] From NEMA Statistical Department. See Appendix.

imports declined to 82.0 percent — down from 88.1 percent in 1966. Also, her share of the U. S. market fell to 17.2 percent in 1967. Japanese imports may have fallen faster than the softening of U. S. demand warranted. An important factor was the poor in-service performance of NGK suspension insulators causing operating difficulties. The difficulties seem to have arisen from use of a brittle body. Thus, TVA insulators shattered upon impact and caused line drops. As a result of these line drops, TVA removed NGK Insulators of America, Inc., the major Japanese supplier, from their list of acceptable suppliers of suspension insulators from mid-year 1966 to late summer, 1967. Nevertheless, during this period TVA continued to use NGK as their primary supplier of other types of insulators.

The recent rise in French and Italian imports of suspension insulators stems directly from the difficulty TVA had with Japanese insulators. In October, 1966, TVA purchased 25,000 suspension insulators made by Sediver, a French manufacturer of glass insulators. The purchase was not open to competitive bidding and was specifically earmarked to replace Japanese insulators. Subsequently, TVA made purchases of suspension insulators from Cogenel, another French manufacturer, and an Italian manufacturer, Richard Ginori. The French and Italian firms are each substantial, highly regarded in Europe, and capable of producing large quantities of insulators. Cogenel, for example, is the American name for a division of Alsthom and Compagnie Générale d' Electricité (C.G.E.), which was reorganized into three organizations in 1964,

employing 10,000 persons. Their combined capital is \$25.6 million, and annual sales are approximately \$100 million. Similarly, Societa Ceramica Italiana d' Richard Ginori is Europe's largest ceramic producer with a full line of ceramic products.

In 1963 NGK won 100 percent of the contracts awarded by Bonneville Power Administration and 76.5 percent of the contracts awarded by Tennessee Valley Authority. Their performance at Bureau of Reclamation was similar. The success of NGK at these agencies has been so consistently high that most American producers no longer bid. The lowest share of awards taken by NGK was 45.6 percent from Bonneville in 1964. The reason was one large award to Sediver, for suspension insulators. The percentage share of awards understates NGK's success. NGK bid on 62 groups of insulator orders at Bonneville between January 1963 and January 1967. They won 50. Of the remainder, nine were awarded to other foreign bidders, two to U. S. manufacturers, and one was not awarded.

This is significant. When NGK has lost an award, it has usually been to other foreign competitors, notably Sediver and Cogenel, French producers, and Richard Ginori, Italy's leading ceramics producer. Both are close to NGK in bid prices. For example, in June, 1967, Bonneville offered to purchase 5,508 station post insulators rated at 500 KV. The bids were NGK \$389,221.20, Cogenel \$421,362.00, and AGROB (a German firm) \$413,100.00. The only other bidder was Independent Engineering Company, a California based company that offers British insulators; their bid was \$496,821.60. Thus, if NGK uses discriminatory prices to maintain its position in the United States market, these prices must be reflected in the prices tendered by other foreign bidders.

NGK enjoys a substantial price advantage over American producers. An analysis was made of the differences in NGK and U. S. manufacturers' bids on 35 contracts for suspension insulators purchased by TVA and Bonneville. NGK won 31 of these contracts. Of the 31, 10 were awarded to NGK on bids that were between 10 and 20 percent below U. S. manufacturers'. Another 10 contracts awarded NGK showed a 20 to 30 percent advantage for NGK. In 8 cases, NGK's bids were 50 percent or more below U. S. producers' bids. NGK's low bids have enabled them to capture about three-quarters of the purchases of both these major public power agencies.

NGK SHARE OF U. S. PUBLIC POWER MARKETS

	1963	1964	1965	1966
Bonneville Power Administration				
Total Insulator Purchases	$830,224	$249,114	$2,353,668	$2,908,506
Insulator Purchases from NGK	830,224	113,614	1,624,005	2,162,957
NGK Share of Total	100%	45.6%	69.0%	74.4%
Tennessee Valley Authority				
Total Insulator Purchases	$628,404	$497,884	$920,739	$1,603,957
Insulator Purchases from NGK	480,439	466,106	818,107	1,246,756
NGK Share of Total	76.5%	93.6%	88.9%	77.7%

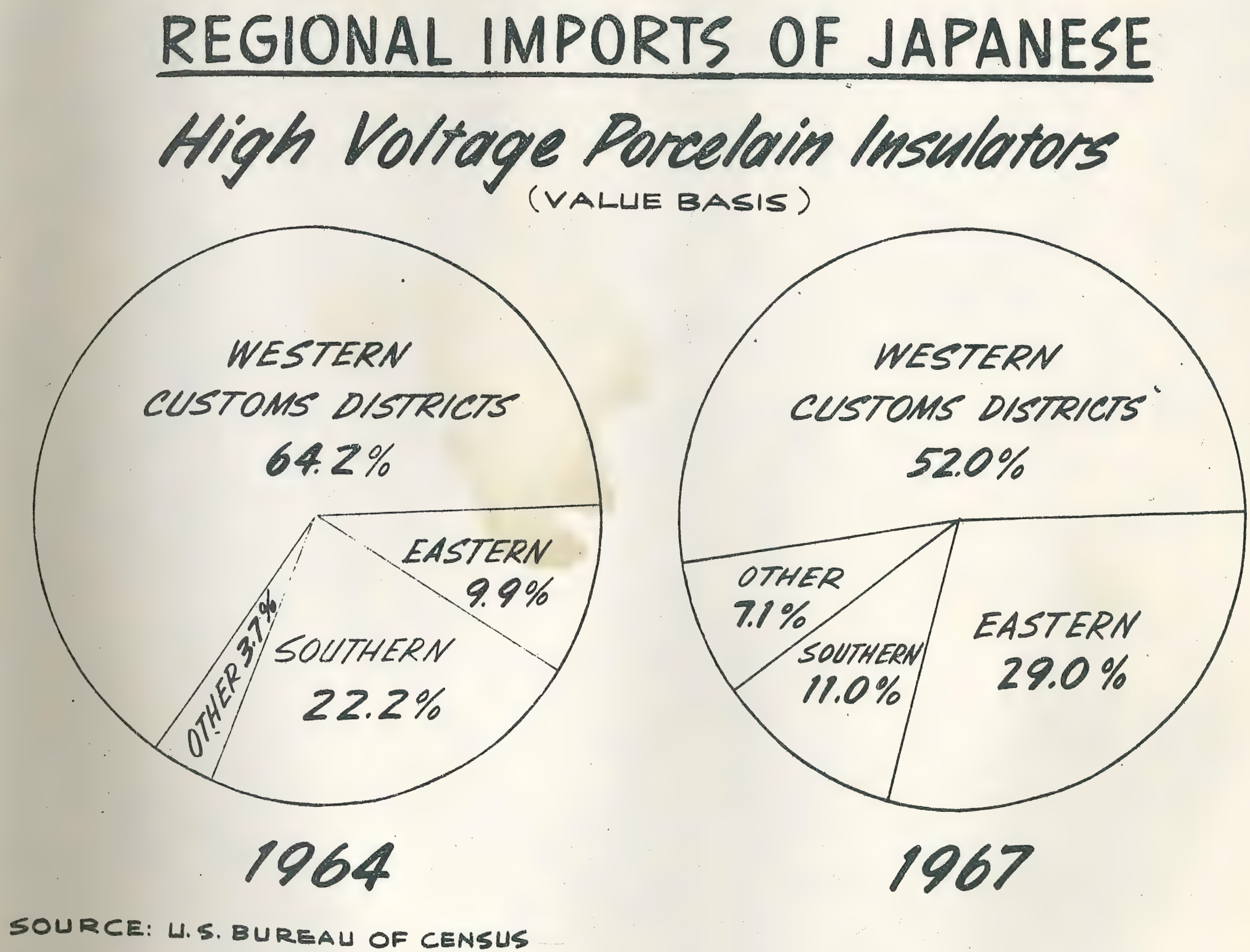
As the insulator needs of TVA and Bonneville grew, NGK's sales grew. TVA purchased $1.6 million of insulators in 1966, of which $1.2 million or 77.7 percent went to NGK. It was during 1966 that TVA temporarily removed NGK from its list of acceptable suppliers for poor performance by their suspension insulators. If this had not happened, NGK sales to TVA would have been even higher.

The growth in total insulator needs by TVA and Bonneville was accompanied by a shift in the type of insulators needed. In 1963, 82.5 percent of the insulators NGK sold to TVA were suspensions. By 1966, the proportion had dropped to 57.6 percent. The picture at Bonneville was similar but not as abrupt; suspension insulators represented 78.8 percent of NGK sales in 1963 but only 63.5 percent in 1966.

PROPORTION OF SUSPENSION INSULATORS
PURCHASES TO TOTAL INSULATOR PURCHASES

Purchases of suspension insulators as a percent of total insulator purchases by:	1963	1964	1965	1966
Bonneville Power Administration				
From NGK	78.8%	41.8%	50.3%	63.5%
All Suppliers	78.8	73.5	64.4	63.9
Tennessee Valley Authority				
From NGK	82.5	62.9	54.7	57.6
All Suppliers	84.5	58.9	57.6	55.6

The changing pattern of NGK sales to the public power agencies is evident in the distribution of insulator imports from Japan. Japanese imports first entered the United States through Western ports. In 1964, when the Japanese were in their early stage of market penetration, West Coast ports handled 64.2 percent of total imports. Most of these imports



went to the Bureau of Reclamation and the Bonneville Power Administration, which are both closest to Western ports. Purchases by the Tennessee Valley Authority, the other federal power agency, were the reason for the substantial share of imports handled through Southern ports, especially New Orleans. In 1964, imports through Southern ports represented 22.2 percent of all imports.

By 1967 the regional distribution of imports had changed significantly. West Coast ports still handled the majority of imports, but Eastern and Mid-West ports (included in the above chart in Other) accounted for sharply increased shares — 29.0 percent and 5.5 percent respectively, as compared with 9.9 percent for the East and 0.2 percent for the Mid-West in 1964. There had also been shifts among Western ports. In 1964 Portland and Seattle alone received 50.0 percent of the Japanese imports, while Los Angeles and San Francisco handled 14.2 percent. By 1967 the Portland-Seattle share had declined to 19.5 percent; Los Angeles and San Francisco were handling 32.5 percent of shipments from Japan. The decline in the Portland-Seattle share did not reflect a slowing down of sales in that area; rather, it reflected a widening in the distribution of Japanese imports including sharply increased purchases by municipal agencies such as the Department of Water and Power of the City of Los Angeles.

Similarly, the decline in the West Coast's share of total imports reflected a sharp increase in sales in the East and Mid-West rather than a slowing of sales in the West. Indeed, on a dollar basis, sales in the West increased by more than any other region. In 1964 Japanese shipments through West Coast ports were $1.2 million. By year-end 1967, they had grown to $5.9 million, an increase of $4.7 million. Growth in imports through Eastern ports was $3.1 million or $1.6 million less. In any event, the redistribution of Japanese sales in the U. S. has resulted in a much more balanced sales pattern for NGK.

REGIONAL IMPORTS OF JAPANESE
HIGH VOLTAGE PORCELAIN INSULATORS
(Valued FOB Japan)

	1964	1967
West	$1,183,173	$5,885,426
East	182,451	3,288,195
South	409,135	1,347,348
Other	68,188	787,679
Total	$1,842,947 *	$11,308,648*

* These totals differ slightly from those presented in the Appendix. The difference occurs because of the way Census series are tabulated.

Source: U. S. Bureau of Census.

NGK MARKETING AND DISTRIBUTION

As long as NGK sales were limited to the federal power agencies, their need for marketing skills was restricted to sales engineering and the ability to complete the lengthy bid forms. But as NGK extends their sales in the U. S. to private utilities, they are learning that there are sharp differences between the market here and in Japan. Some of these differences mean higher operating costs and perhaps increases in price.

The skills required to service customers in the United States cannot be learned in Japan because selling conditions here are very different from those in Japan.

- The Japanese market is more severely restricted in number of manufacturers and customers than the U. S. market.
- The types of insulators sold in Japan differ from those sold in the U. S.
- Marketing requirements in the U. S. are more demanding than in Japan.

The Japanese Market

The Japanese electric utility industry consists of nine government-controlled utilities. This sharply contrasts with the over 1,200 mostly investor-owned, electric utilities which buy insulators in the United States. The nine Japanese utilities accounted for 40.3 percent of domestic high voltage insulator purchases in Japan in the first four months of 1967. Another 46.5 percent of insulator purchases in Japan were made by about 20 electrical equipment manufacturers. Purchases by electrical equipment manufacturers do not represent as high a portion of total insulator sales in

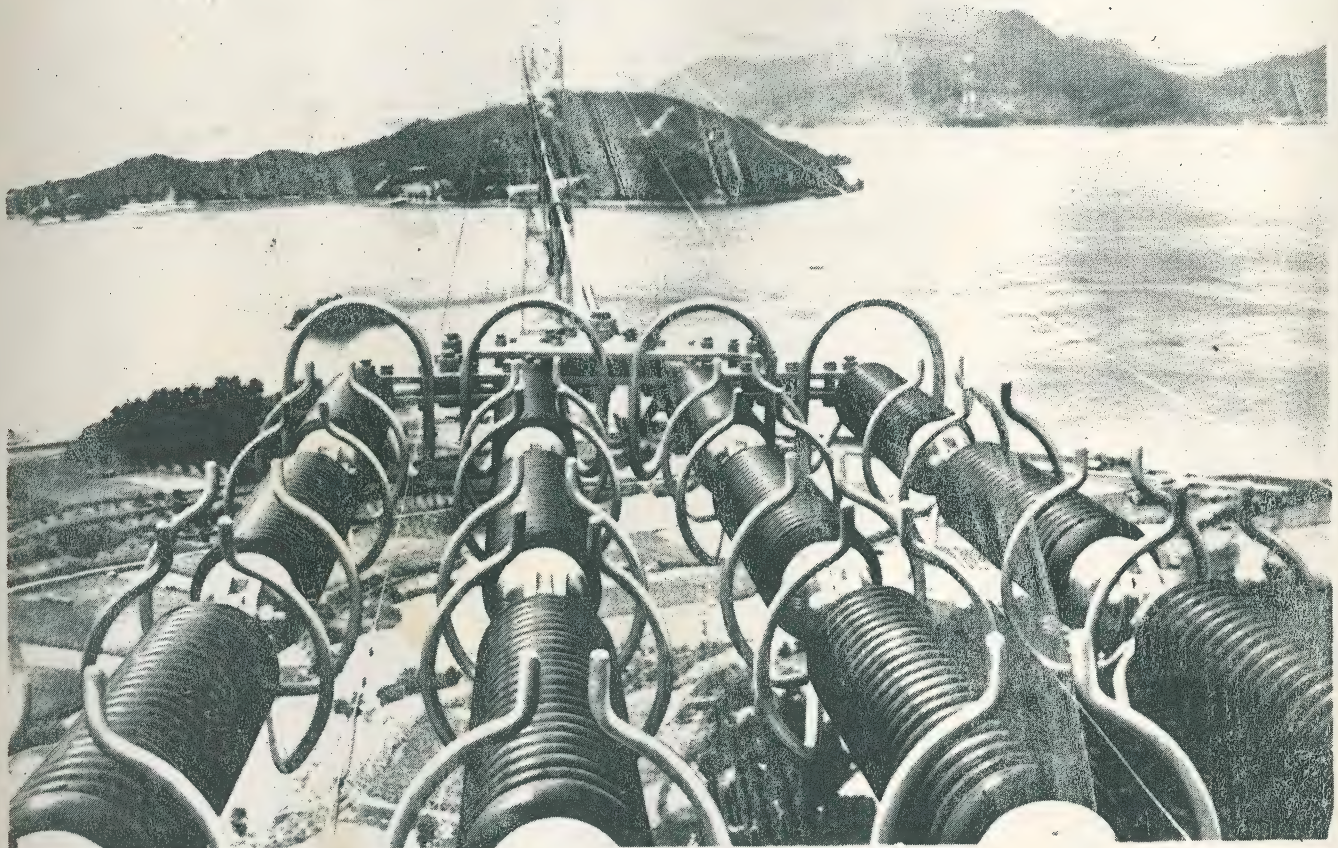


Figure 1: Long rod insulators on a 220kv transmission line

the United States. The government-operated Japan National Railway System accounted for most of the remaining 13.2 percent of the Japanese industry home market sales. U. S. insulator sales to electrified railroads are very small.

The differences in customer distribution reflect differences in types of insulators sold. Japanese manufacturers' sales include a higher proportion of sales to electrical equipment manufacturers — bushing and circuit breaker porcelains, switch insulators, etc. The Japan National Railway System purchases a large number of long-rod insulators which they use in place of suspension insulators. Japanese utilities also are moving away from suspension and pin type insulators toward long-rod and post type insulators. (See Figure 1.) American utilities have not moved as quickly in this direction. Suspension insulators account for 30 percent of NGK sales in Japan but 75 percent of their exports to the U. S.

JAPANESE MANUFACTURERS' SALES
BY TYPE OF CUSTOMER

	% of Total Sales	
Type of Customer	Japan	U. S.
Electric Utilities (9)	40.3%	70.0%
Electrical Equipment Manufacturers (20)	46.5	30.0
Railroads and Others	13.2	nil
Total	100.0%	100.0%

The small number of customers and the geographic limits of the Japanese market make a "door to door" approach the most effective selling device for Japanese manufacturers. To cover Japan effectively with salesmen, NGK maintains eight sales offices — three in Tokyo. The eight offices have a combined staff of 126. The marketing philosophy of NGK Insulators was summarized by Mr. K. Fukuta, Executive Managing Director, who said:

> Our company considers direct, personal contacts with customers more important than any other means of advertisement.

As a result, NGK advertisements are limited to trade and professional magazines. Such expenditures were less than 0.5 percent of sales in 1966.

NGK's dominant position in the Japanese market makes advertising unnecessary for another reason. There is little opportunity for switching customers away from competitors especially since the other Japanese manufacturers do not engage in price competition. According to purchasing department staff members at Tokyo Electric Power, the number of insulators purchased from any manufacturer is determined by an elaborate procedure which includes, as a primary determinant, historical shares of insulator awards given each manufacturer. For example, NGK has traditionally received orders for about 80 percent of Tokyo Electric's insulator needs. The remainder has been awarded to Osaka Togyo Kaishia. It would be very unusual for these shares to vary significantly in any year.

Similarly, prices are determined by negotiation between manufacturer and purchaser. Price increases (there have been no decreases in recent years) are set according to increases in manufacturers' operating costs adjusted by a factor for increased productivity. The assistant purchasing director of Kansai Electric Power, Japan's third largest utility, expressed concern that "the manufacturers must be allowed to make normal profits."

Japanese utilities also help their suppliers by ordering well in advance of delivery requirements. Normal lead time is two years. This spread is similar for orders placed by the Japan National Railway System.

Selling conditions in America are very different from those in Japan. (a) American producers are sharply price competitive. (b) The market for insulators is widely dispersed both in number and location of customers. (c) Extensive marketing effort is needed to sell quality, reliability, and service in the U. S. investor-owned utility markets.

NGK has not been fully exposed to these differences largely because of their success in the public power markets, where purchase decisions are made primarily on the basis of bid prices with little concern for other aspects of the sale. But those successes have provided a sales base which produces the revenues needed to build markets among private utilities. Their major efforts are directed through NGK Insulators of America, Ltd.

NGK INSULATORS OF AMERICA, INC.

NGK officials do not speak of any basic price advantage in their insulators. They attribute rising imports to high U. S. demand. They also give some credit for their success to the establishment of an American subsidiary in October, 1965. Further, they feel it will be this organization which will enable them to maintain their position if and when U. S. demand falls.

According to Mr. P. Y. Matsura, President of NGK Insulators of America, Inc., his company is able to service customers much more efficiently than did NGK's previous representative in the United States — Mitsubishi International, Ltd. When Mitsubishi handled NGK sales, the quality of service varied greatly for two reasons: First, sales of insulators were too small for Mitsubishi, a huge trading company, to give insulators sufficient attention. Second, frequent changes in the personnel assigned to handle insulators prevented creation of close personal contacts with customers. NGK of America was set up to correct both deficiencies. Mr. Matsura pointed out, however, that Mitsubishi still is involved with NGK's sales in the U. S. and handles the paper work necessary to deliver orders written by NGK salesmen.

After the NGK salesman writes the order, he turns it over to Mitsubishi. They submit the order to Japan and prepare the invoices for both freight and U. S. Customs. Mitsubishi receives a commission of 5 percent for their service, according to Mr. Matsura. This conforms to their commission on other similar products. Since Mitsubishi does the clerical work, NGK's personnal are free to work solely on sales and sales promotion.

NGK's staff is distributed among six offices throughout the U. S. The main office is at 277 Park Avenue, New York, on the same floor as Mitsubishi's New York office, a further reflection of the close relationship between the two. There are two offices in California, one in San Francisco to handle sales in the North and the other in Los Angeles to handle the South. The need for two offices in California reflects the importance of the West Coast as a source of sales for NGK but also reflects the strong desire of NGK to sell in the U. S. market.

NGK INSULATORS OF AMERICA, INC.

STAFF OF 24

<u>Japanese Staff</u>	
Managers and Salesmen	10
Engineer	1
<u>U. S. Staff</u>	
Secretaries and Clericals	13

SIX OFFICES

New York
Chicago
Houston
Los Angeles
Pittsburgh
San Francisco

OPERATING BUDGET

$300,000 per year (estimated)

The other offices are in Chicago, Houston, and Pittsburgh. NGK maintains one Japanese national each in the Houston and Pittsburgh offices. The offices in Chicago, Los Angeles, and San Francisco are each serviced by two Japanese nationals. These permanently assigned salesmen are aided by a rotating staff of engineers. According to Mr. Matsura, NGK has four engineers trained to work in the United States. Each engineer spends three to four months here and then returns to Japan to work out problems he encountered in the United States. In addition to these eleven Japanese nationals, NGK of America employs a secretarial and clerical staff of about a dozen. Total employees number 24.

Sales efforts are helped by pamphlets, brochures, and technical papers in addition to an elaborate catalog. NGK has not yet engaged in national advertising, but, according to Mr. Matsura, they expect to develop a program for national trade publications which will begin to appear shortly. In addition to help offered by the engineers, NGK's technical services include free access to their elaborate high voltage insulator testing laboratory at Komaki, Japan.

The most important aspects of sales promotion for foreign competitors in the U. S., said Mr. Matsura, are "to establish in person contacts and to convince the customer of the product's quality and the continuity of reliable supply." According to Mr. Matsura, President, NGK Insulators of America, "it takes three to five years of consistent sales effort to establish a sound market."

The pattern of import growth lends substance to Mr. Matsura's comments. NGK has done best in areas which (a) offered contracts large enough for Mitsubishi to be attracted, and (b) considered price above service. This explains the rapid acceptance of NGK insulators by public power agencies which purchase on a lowest public bidder basis.

NGK hopes an increased share of U. S. business will shift away from suspension insulator sales and away from public power agencies. They would like to sell more to investor-owned utilities and electrical equipment manufacturers. They are especially hopeful about sales of solid core station post insulators. NGK officials' short-run goal is for sales in the U. S. of about $1 million per month on an FOB basis. This is the level they achieved in 1966 and 1967.

A fall in demand will give NGK both competitive advantages and disadvantages. The clearest advantage will be price. In recent contracts awarded to NGK by TVA and Bonneville, NGK bids were from 15 to 70 percent below those of U. S. companies. Assuming a 12 percent "Buy America" differential for U. S.-made products over foreign made, the gap between U. S. and Japanese prices becomes 3 to 58 percent. Even a 25 percent cut by American producers will not eliminate NGK's price advantage. In the case of municipal or state power agencies, the "Buy America" differential in favor of U. S. companies does not apply. U. S. producers would have to cut their prices by the full amount of NGK's advantage. U. S. producers may not need to meet the price of NGK at investor-owned utilities. Until now, NGK has not been as successful in penetrating the investor-owned utility market. But as NGK becomes better known, the differential these utilities may be willing to pay to continue buying from U. S. companies will probably decline.

The greatest disadvantage faced by NGK is delivery time. Shipment from Nagoya to western ports takes about nine days plus a week to clear Customs. This gives U. S. producers a two-week advantage on delivery. For East Coast ports, the advantage expands to 45 or 50 days. Since NGK does not inventory insulators in the U. S., American producers will have a great advantage if utilities begin demanding spot deliveries once again. The question then becomes, can NGK offer prices sufficiently low to compensate customers for longer delivery times, or will they inventory in the U. S. ?

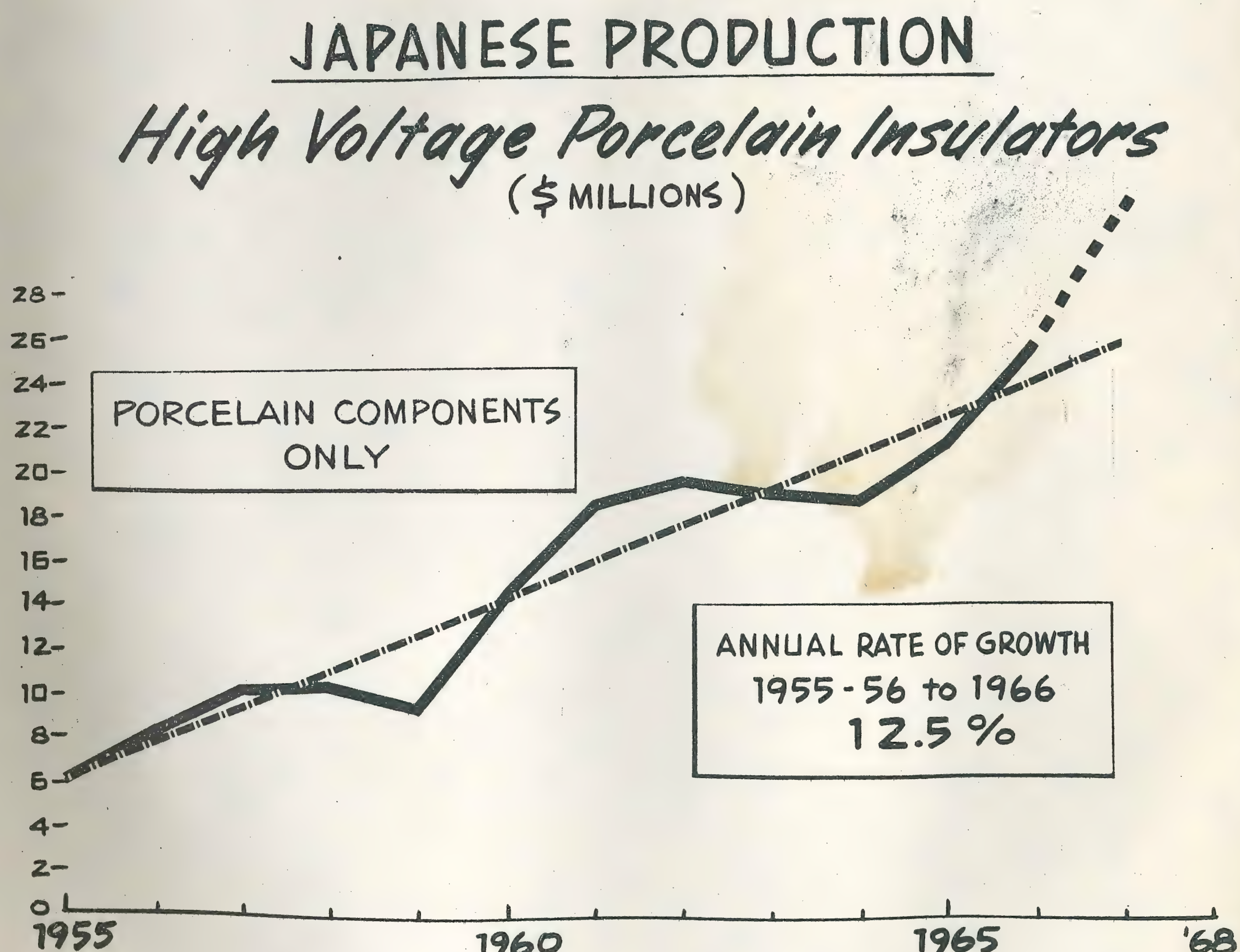
Certainly, the establishment of NGK of America indicates that the Japanese are determined to stay in this market. If they cannot effectively compete on service and product quality alone, they will undoubtedly turn to their most powerful advantage — low prices.

Thus far the emphasis has been on the U. S. market and the pressures that can shape Japanese exporters' policies. Just as increased competition from French and Italian imports, or a decline in U. S. demand, will affect NGK's attitudes and policies toward this market, so will conditions in Japan. The next few sections of this report discuss the structure of the Japanese industry, its reliance on exports, and the availability of alternative markets for these exports.

III. THE JAPANESE INDUSTRY

INDUSTRY SALES

The Japanese high voltage insulator industry enjoyed rapid growth in sales between 1955 and 1966. In contrast to the 8.2 percent increase in U. S. manufacturers' sales of insulators between 1956-57 and 1964, Japanese producers' sales doubled (up 98.1 percent). The Japanese sales expansion was



interrupted twice, in 1959 and 1962-1963. One cause of the 1959 setback was a slowdown in the rate of additions to electricity producing capability by Japanese power companies in 1957 and 1958. This caused a slowdown in spending for transmission and distribution and a consequent drop in insulator sales. Exports also declined in 1959 by an amount almost equal to the decline in domestic sales, and the quantity of Japanese insulators sold declined by 9.3 percent. The decline was somewhat sharper on a value basis — 11.9 percent. The second setback began in 1961 and continued to the end of 1962. During these two years, the domestic market declined by 33 percent in both quantity and value. A sharp increase in export sales, however, compensated for the decline in domestic sales, and total sales remained almost level in 1962 and increased in 1963.

The data presented in the chart above measure only the porcelain parts of insulators produced and do not include the hardware. As a result, the size of the Japanese industry is significantly understated. If the United States experience is used as a guide, the actual size of the Japanese industry is estimated as about $70.0 million in 1966, or slightly less than the size of the American industry. This is more in line with statistics from Japan's largest producer, NGK, which reported 1966 sales of $54.9 million. Since the proportion of metal components in insulators does not change abruptly from year to year, the data represent the year-to-year movements in Japanese insulator sales. These statistics are collected by the Japanese Ministry of International Trade and Industry (MITI). This agency is especially important to Japan's economy. The brief description which follows highlights the role MITI plays in advancing high export industries such as insulators.

MITI'S RELATIONSHIP TO INDUSTRY

MITI occupies a position with respect to industry not found among other government agencies in the free world. At one extreme they collect statistics on an industry basis, and they are the Japanese counterpart of the U.S. Bureau of the Census. At the other extreme they plan the structure of Japanese industries and work to implement their own plans by a combination of moral suasion and directives. While their delegated powers are not particularly comprehensive, they enjoy great power, in fact.

Japanese industry works very closely with MITI in a spirit of cooperation rarely found between government and industry. Some of this cooperation is imposed since firms and industries rarely resist MITI.

Each major industry projects its future pattern of production and sales, including exports, and these are confirmed or revised by MITI officials. Periodic reviews are used to give further direction and to encourage lagging sectors or in periods of recession to "recommend restriction of production." Special emphasis is given to Japan's export industries where rapid expansion of trade with the U.S. has been encouraged.

In the export trade MITI can exercise strict control, and cartels are allowed to operate. For example, export agreements among producers are permitted under the Export-Import Transactions Law. This law gives MITI broad powers to control Japan's international trade. In the past, MITI has set export prices, imposed quantity restrictions on exports and verified product quality.

> The Export-Import Law (Article One) states that its purpose is "to prevent unfair export transactions, establish order among export and import transactions and thereby provide for the sound development of foreign trade."[1]

Thus, MITI does much to supervise the development of Japan's trade to ensure that its growth is sound.

Increasing Reliance on Exports

The Japanese government's priority on export sales, as evidenced by the activities of MITI, combined with a strong desire by Japanese manufacturers to increase their production continuously, may have given rise to a policy of aggressive, discriminatory pricing in export markets. Since 1957, when demand was at its peak, annual insulator sales (quantity basis) in Japan have not exceeded the 1957 peak by more than 4.5 percent. Between 1955-1957 and 1964-1966, domestic sales increased by 48.1 percent; all of this growth occurred by the end of 1961. In contrast, export sales grew much faster, by 246.4 percent between 1955-1957 and 1964-1966; most of this growth took place after 1961. The difference in the rates of growth of home and export market sales has resulted, especially since 1961, in an increased reliance by the Japanese on export sales. The change in market share accounted for by exports is presented in the chart below. Exports grew from 31 percent of total sales in the period 1959-1961 to 56 percent in 1964-1966. The abrupt rise in export sales was also accompanied by a significant shift in value of sales.

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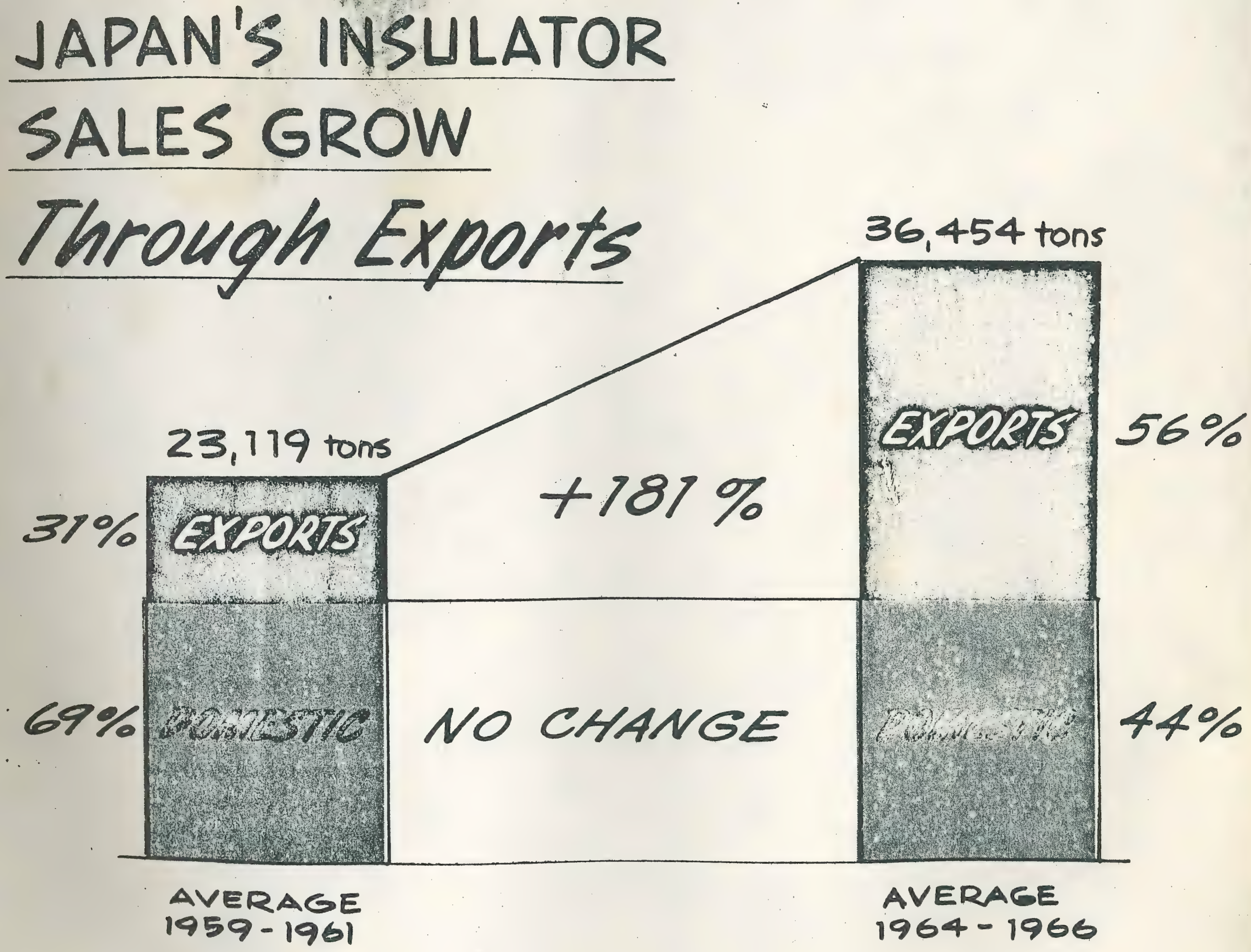
[1] Yoshio Kanazawa, "The Regulation of Corporate Enterprise," in Arthur Taylor von Mehren, Law in Japan, Harvard University Press, 1963, p. 497.

Following the sales slump of 1959, Japanese insulator sales at home almost doubled (+83.7 percent) by 1961. But the value of these sales more than doubled in the same years (+139.5 percent). Consequently, the unit value of Japanese home market sales increased by 30.4 percent. Although unit values are not prices, they suggest the following inference: the rise in the value of



sales was too abrupt to reflect only a change in product mix and must have included a substantial increase in price. The increase in home market sales was accompanied by a slight decline in export market sales on a quantity basis together with a 20 percent rise in the unit value of export sales. Japanese manufacturers were evidently faced by high demand in the home market, and they raised prices and cut back export shipments to take maximum advantage of that demand.

In 1962, however, Japanese producers were faced by a retreat in home market sales. Domestic sales declined sharply from the 1961 peak, by 23.1 percent on a quantity basis and 21.7 percent on a value basis. The unit value of sales rose slightly; prices did not move downward as expected with a decline in demand. The situation in the export market in 1962 was also sharply different from 1961. Sales to foreign countries doubled (+106.8 percent) while unit values dropped sharply, by 12.6 percent.

There are several alternative possibilities which fit these circumstances. One is that demand in the export market rose sharply, together with a drastic change in product mix which affected the unit values. This rise permitted Japanese manufacturers to utilize their capacity and maintain home market prices. A second possibility recognizes the existence of monopoly power in the Japanese home market, capable of holding prices in a declining home market while aggressively seeking export markets through discriminatory pricing.

Quite independent of either explanation is the wide gap in unit values which appeared in domestic and export sales between 1959 and 1962. From a \$95.26 per metric ton difference in 1959, the gap between home market and

export market unit values grew to $251.17 by 1962. On an index basis, export prices were only 4.9 percent above 1955-1956 prices while domestic prices had risen 41.3 percent. Whether the differential was intended or not, it is clear that some differential must have existed at year-end 1962. The change was much too abrupt to have been caused solely by changes in product mix.

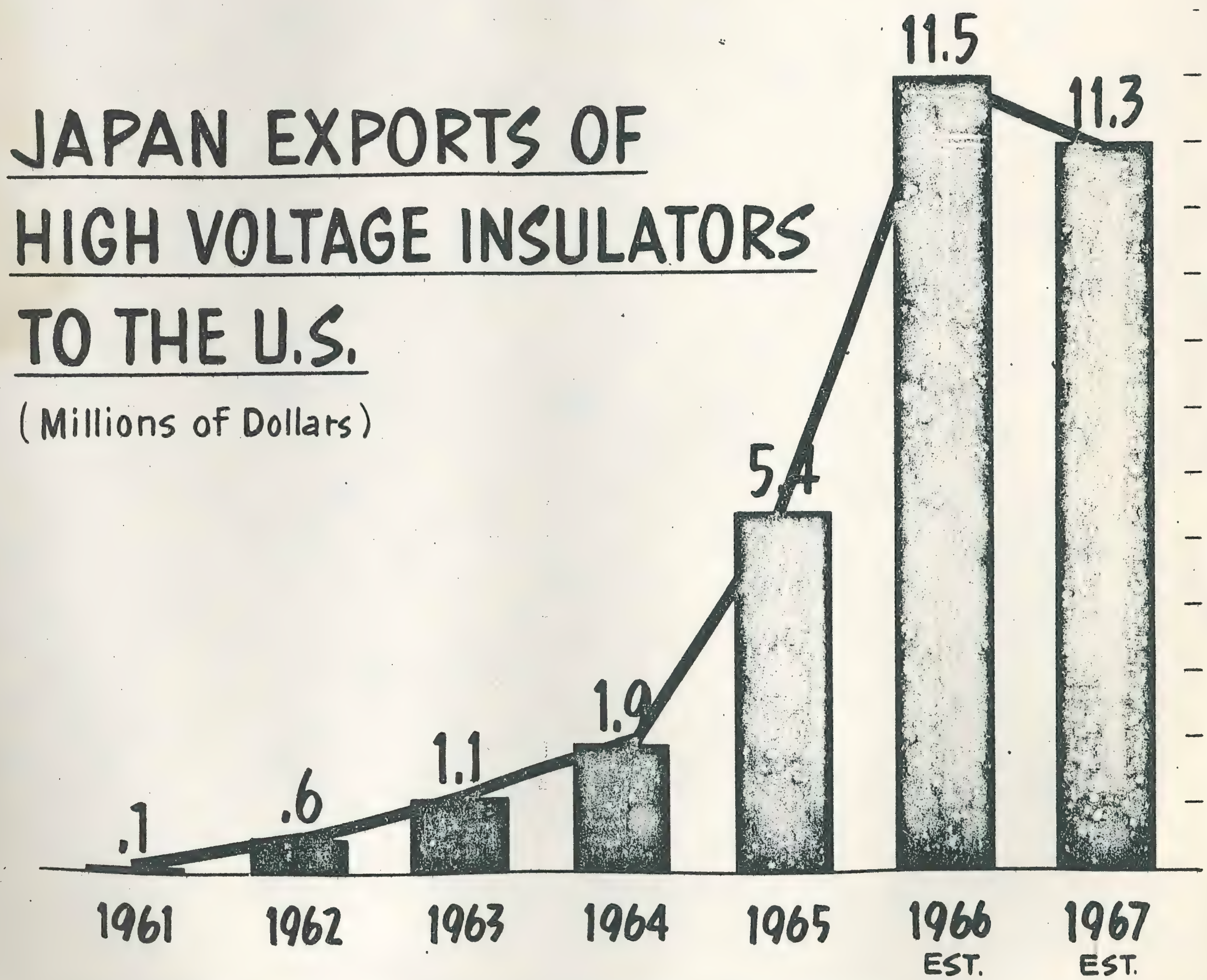
Since 1962 there have been no further abrupt changes, and the gap in unit values has widened. In 1966 the difference was $269.61 per metric ton — the unit values were $787.42 for domestic sales and $517.81 for export sales. It is possible that differential pricing still exists. The analysis of Japanese production costs and home market prices which follows will focus on whether there is discriminatory pricing between home market and export markets.

AVERAGE UNIT VALUES OF JAPANESE
PORCELAIN INSULATOR SALES
(1955-56 = 100)

	Export Market		Home Market	
	Unit Value	Index	Unit Value	Index
1959	$447.72/met ton	100.1	$542.98	105.5
1960	513.17	114.7	690.64	135.5
1961	536.70	120.0	707.98	138.9
1962	469.14	104.9	720.31	141.3

JAPANESE EXPORTS BY COUNTRY

By turning to the export markets, Japan has been able to find outlets for new capacity. Indeed, in the past few years it has been the United States market which allowed the Japanese to maintain their rapid growth in production. By 1965 the United States had become Japan's major foreign customer for insulators. The rise in the U. S. share of Japanese exports was abrupt — from 3.8 percent in 1961 to 8.3 percent in 1963 and 38.9 percent in 1965. In 1966 the U. S. accounted for about 55 percent of total Japanese exports.



Source: JETRO — Foreign Trade of Japan, 1961-1966 annually. 1967 estimated from U. S. Import Statistics.

In order to sell here in volume, NGK was required to:

- make significant additions to capacity, and
- reallocate export sales among countries.

Efforts to add new capacity were reflected in this typical statement from a Japanese trade publication. These remarks were included in an article reporting that NGK was operating at capacity, largely because of exports to the United States.

> The Company, therefore, decided to expedite the secondary construction of Komaki factory (monthly production capacity 100,000,000 Yen) [$280,000], which has been under construction since the end of last year (1965), to be completed before May or June in order to increase the capacity by almost 10 percent. It is also determined that a total of approximately 1,500,000,000 Yen [$4,200,000] need be invested for improvement of each factory to increase production capacity sufficient to digest orders.[1]

According to NGK company data, the increase in insulator production capacity was greater than the reported 26 percent, from 5,000 metric tons to 6,300 metric tons per month. Plans for future additions to capacity will be discussed in the section on NGK.

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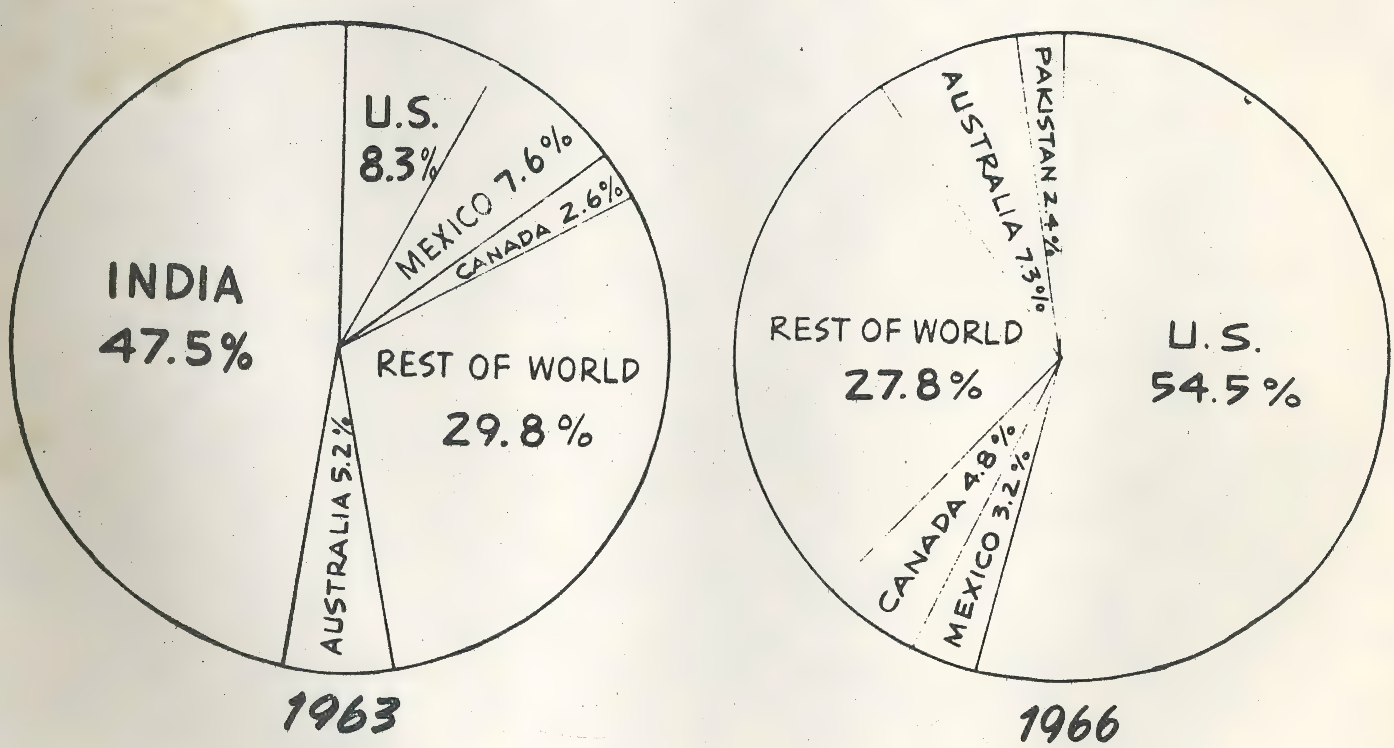
[1] Sogo Tsushin Togyohan, #810, February 22, 1967, p. 5.

INDIA

The reallocation of export sales is summarized in the chart below. The major shift was from sales to India to sales in the U. S. The decline in sales was abrupt and was caused by two factors. First, Southeast Asia and India are "dumping grounds" for Japanese ceramic products. When market conditions become better elsewhere, Japanese exports are quickly shifted to take advantage of better sales opportunities. This has been especially true for sales in the American market, which Japan regards very highly.

MARKET FOR INSULATORS



SOURCE: JETRO Foreign Trade of Japan

Second, India had begun to develop its own porcelain insulator industry. A small insulator plant was established in Mysore, India, in 1954, using NGK Insulator, Inc. technical assistance. By 1966 this company had a production target of 5,000 tons per year. In May 1966 the company was reorganized as Mysore Porcelains, Ltd. with capital of $1.3 million. NGK held 20 percent of the capital stock; the remainder was controlled by Indian interests. This company is able to provide a substantial share of India's insulator needs.

The United States market is regarded as the main source of growth for exports in future years, but the Japanese are also seeking to develop other markets.

According to Japanese publications:

> Besides the American market, a sharp increase in exports is expected to Korea because of the ratification of a Japan-Korea agreement; sales representatives and technical staffs are to be sent to agencies in Korea. There is also a plan for improving services by sending managerial representatives to India, Pakistan, Indonesia, etc. Exports to Europe are at a monthly rate of $200,000.
>
> The Japan-Russia Trade Agreement was revised and the company anticipates growth in insulator exports for development of Siberia...

It is relevant to ask whether the Japanese could switch sales away from the U. S. to other countries in the event of a decline in demand here. Despite the optimism of Japan for developing new markets, whether these markets cited could absorb the number of insulators currently shipped from Japan to the U. S. is questionable. For example, a 30 percent drop in sales to the U. S. would

require that about $3,000,000 of suspension insulators be sold elsewhere. This is more than the total amount of insulators purchased by Australia, India, and Canada in 1966 — NGK's largest markets, next to the U. S.

In February, 1968, NGK announced that:

> Because of its increasing importance as an export market, the company has sent Mr. Katsumi Fukuda, Managing Director, to South Korea for an observational tour, and is preparing for a positive plan for the promotion of export to the country.

Yet the total size of the Korean market is about equivalent to purchases from NGK by one major U. S. utility — between 1 and 1.5 million dollars per year.

In addition to the limited size of the markets in other foreign countries, several of the countries mentioned in the quote above are planning to develop their own insulator production capacity. These countries' plans do not envision supplying all of their insulator needs domestically. But the plans do establish a framework of government concern. One expression of this concern undoubtedly would be to limit or restrict import competition so as to assure the development of domestic insulator manufacturers.

WEST PAKISTAN

The Indian example of the development of domestic insulator production capability has already been cited. A similar project by NGK involved the Emko Co. of West Pakistan, a manufacturer of electric machinery, appliances and low voltage insulators. NGK received an initial payment of $200,000 plus royalties of 3 percent of sales for an unspecified number of years. For these fees NGK agreed to deliver by March 1967 one complete factory, including a tunnel kiln,

capable of producing 100 tons per month of special high voltage insulators including suspension insulators. NGK also agreed to provide three engineers to start up the factory and to provide further technical guidance for ten years.

KOREA

The Korean government is especially anxious to develop a ceramics industry. Included are plans for producing high voltage insulators.

A proposal for a Ceramic Center in the Republic of Korea was submitted to AID in early 1966 by the Korean government through its Ceramic Center Committee. The plans called for the establishment of a Pottery Center to be operated by a government enterprise, Dai Han Iron Mining Development Corporation. It was estimated that $816,750 in foreign exchange would be required for the Research Institute.

The proposal was rejected by the AID mission because the funds requested were about five times the available funds. The Koreans were determined, however, and a new plan was formulated independent of the Dai Han Iron Mining Development Corporation.

A Ceramic Center, consisting of a Ceramic Research Institute and six model plants — one for insulators — is already under construction. It is expected to be the focal point of a Ceramic Town in Masan, Kyungsangnamdo District in the southeast corner of Korea. The area is rich in kaolin, pyrophyllite, clay, and feldspar.

The model insulator plant is to be completed in mid-1968. Foreign exchange requirements for equipment and know-how to build the plant were put at $1.5 million. Production capacity was set at 2,880 metric tons per year.

ALTERNATIVES FOR JAPAN

If no alternative export markets can be found, and demand in the U. S. falls, the Japanese will be faced with two alternatives. They could either try to sell more insulators at home or they could increase pressure in the U. S. for greater market penetration through lower prices.

Increased sales at home are very unlikely as was admitted by Mr. K. Murase, Manager of the Overseas Division of NGK Insulators, Inc. Sections following analyze the Japanese industry to determine whether they could lower prices to the United States, without engaging in unfair discriminatory pricing. And, more important, the report covers whether such discriminatory pricing has existed in the past or exists currently.

JAPANESE INSULATOR MANUFACTURERS

The Japanese porcelain insulator industry is dominated by NGK Insulators. It accounts for 80 percent of domestic production and virtually all of Japan's insulator exports. NGK estimates it supplies 25 percent of the free world's total insulator production. The second largest company in Japan is Osaka Togyo Kaisha (OTK). This company is less than one-tenth the size of NGK with sales of less than $5 million in 1966, compared with $55 million for NGK.

In addition to these major producers, there are five smaller manufacturers whose collective output equals about 10 percent of Japan's annual production of special high voltage insulators. None of these smaller manufacturers exports a significant number of insulators. Capsule descriptions of these small producers follow. The term special high voltage insulator is designated by Japanese law

and refers to porcelain insulators for use on systems operating above 7,000 volts AC or DC. The law also designates high voltage insulators as those for use on systems of less than 7,000 volts but more than 600 volts AC and 750 volts DC. A list of 45 Japanese companies which produce high voltage insulators is included in the Appendix. The list includes company names, locations, amount of capitalization and number of employees.

STRUCTURE OF JAPANESE
HIGH VOLTAGE INSULATOR INDUSTRY

Year Ending March 31, 1967

	NGK	Osaka Toygo Kaishai
Company Sales	$54,900,000	$4,780,000
Net Income	2,300,000	156,000
Capitalization	8,300,000	1,100,000
Factories	4	1
Insulator Production Capacity	6,300 tons/mo.	500 tons/mo.
Employees	5,205	609

JAPANESE SPECIAL HIGH VOLTAGE PORCELAIN INSULATOR MANUFACTURERS

NASU DENKI-TEKKO CO., LTD.

Incorporated: May, 1939

Address: Furutaka Building, 1-79, Shinjuku,
Shinjuku-ku, Tokyo

Capital: 400 million yen ($1,111,111.00)

Name of President: Jinkuro Nasu

Number of Employees: 921

Products:	Percent of Sales
Pole Line Hardware	47
Steel Tower	37
Porcelain Insulator	9
Others	7

Sales (year ended March, 1967)	
Total Company	$8,364,000
Insulators	752,760

Net Profit (year ended March, 1967)	
Total Company	$255,000

Raw material consumption For Porcelain Insulators only (6 months ended September 30, 1966)	
Feldspar	48 metric tons
Toseki (pottery stone)	1,607 metric tons

JAPANESE SPECIAL HIGH VOLTAGE PORCELAIN INSULATOR MANUFACTURERS (Cont'd.)

ASAHI GAISHI, LTD.

Incorporated: July, 1948

Address: 3-24, Kamijo-cho, Kasugai City,
Aichi Prefecture

Current Capital: $250,000.00

Name of President: Kaoru Suzuki

Number of Employees: 283

Products:	Percent in Sales
Special High Voltage Insulators	74
Low Voltage	12
Acid heat resistant porcelain	9
Others	5

Sales (year ended November, 1966)	$1,067,000
Net Profit (year ended November, 1966)	21,000

TONO GAISHI CO., LTD.

Address: 1323 Shinoishi-cho, Toki-shi
Gifu Prefecture

Capital: less than $14,000

Number of Employees: between 100-199

Products:

Special high, high & low voltage
Porcelain insulators
Electric wiring devices

Sales and Profits: not available

JAPANESE SPECIAL HIGH VOLTAGE
PORCELAIN INSULATOR MANUFACTURERS (Cont'd.)

SUZUKI DENJIKI SEISAKU SHO

Address: 208 Mitsuke-cho, Seto-shi
Aichi Prefecture

Capital: less than $3,000

Number of Employees: 0-29

Products:
Special high and high voltage porcelain insulators

Sales and Profits: not available

NARITA SEITO SHO

Address: 70, Dosen-cho, Seto-shi
Aichi Prefecture

Capital: less than $140,000

Number of Employees: 100-199

Products:
Special high voltage porcelain insulators

Sales and Profits: not available

OSAKA TOGYO KAISHAI

Japan's second largest producer, OTK, was founded in 1920 to service the needs of Kansai Electric Power, whose headquarters are in Osaka. The relationship between OTK and Kansai is so close that many of OTK's employees, including their sales manager, Mr. J. Onishi, are former Kansai Electric employees.

The plant and facilities of this company are clearly inferior to those of NGK. Indeed, in the catalog issued by OTK for promoting export sales, many of the photographs of their plant have been extensively retouched to make the factory look cleaner, bigger, and newer. OTK sales in the U.S. are handled by Sumitomo-Shoji, Ltd., another of the very large international Japanese trading companies.

IV: NGK INSULATORS, LTD.

NGK Insulators is said to be the largest ceramics producer in Japan. It operates four factories and employs 5,000 people. The company was originally a division of the Noritake China Co., Ltd., but was made into a separate company in 1919.

Insulators have been NGK's best business, representing 94 percent of NGK's total production on a quantity basis. NGK has never had any difficulty in utilizing its insulator capacity. Between March 1966 and March 1967 for example, extension of facilities at two of NGK's factories, Komaki and Chita, increased insulator production capacity by over 25 percent. This increase in capacity meshed with the high United States demand, and within ten months the company was operating at 96 percent of capacity. Plans for future expansion were already well under way.

The high export demand for insulators seems to have postponed NGK's plans for diversification. According to NGK management, insulator sales will eventually represent 60 percent of company sales. The other 40 percent will be accounted for by machinery and equipment for the chemical industry and by special metal and ceramic products, including "miraclon," a glass ceramic product, and Beryllium alloys and products. One reason for NGK's desire to diversify stems from the fact that insulators accounted for only 84 percent of dollar sales, much lower than their 94 percent of quantity of sales. Production of these other products, however, is still only a small part of the NGK business, as may be seen in the table below. Diversification is still a long way off for NGK.

NGK MONTHLY PRODUCTION CAPACITY
AND CAPACITY UTILIZATION

	March, 1962	March, 1966	March, 1967
Insulators			
Capacity	4,400 tons	5,000 tons	6,300 tons
Utilization	87%	97%	96%
Chemical Machinery			
Capacity	430 tons	350 tons	350 tons
Utilization	90%	57%	77%
Special Metals & Ceramics			
Capacity	15 tons	25 tons	43 tons
Utilization	67%	64%	93%

Other NGK activities include the design and sales of ceramic machinery and kilns. NGK offers assistance in building entire plants. The NGK factories reflect the company's high technical competence. Many of the machines used in producing insulators were made by NGK itself. Some of the designs are copies, however. NGK kilns, for example, are based on modifications of drawings purchased from the United States in 1958.

NGK's four plants are located within an hour's ride of the company's main office and largest plant at Mizuho, in the city of Nagoya. The plants and their capacities are given below:

Plant	Total Area	Mfg. Floor Space	Employees Factory	Employees Office
Atsuta	753,480 sq. ft.	430,560 sq. ft.	1,034	---
Chita	1,787,588	570,492	985	198
Komaki	1,851,408	161,460	604	85
Mizuho	753,480	678,132	860	1,313
Total	6,996,600 sq. ft.	2,486,474 sq. ft.	3,483	1,722*

* Includes 126 office employees in eight branch offices in Japan.

Mizuho

The Mizuho plant is used to produce pin type insulators and small suspension insulators. More and more of the pin insulator capacity is being shifted to production of solid core post type insulators. Mizuho also houses one of NGK's two extra high voltage laboratories.

The plant is situated on a site of 753,480 square feet, of which actual manufacturing floor space accounts for 678,132 square feet. Production workers at the Mizuho site numbered 860 at the end of March, 1967. The number of office personnel was 1,313, reflecting the high concentration of selling and administrative personnel at the company's headquarters. (See Figure 2.)

Atsuta

At Atsuta, NGK produces long-rod and station post insulators. This site is also used for producing special metal products and conducting NGK's basic research and development. Of the 1,034 workers at Atsuta, over 120 are engaged in research programs. (See Figure 2.)

Chita

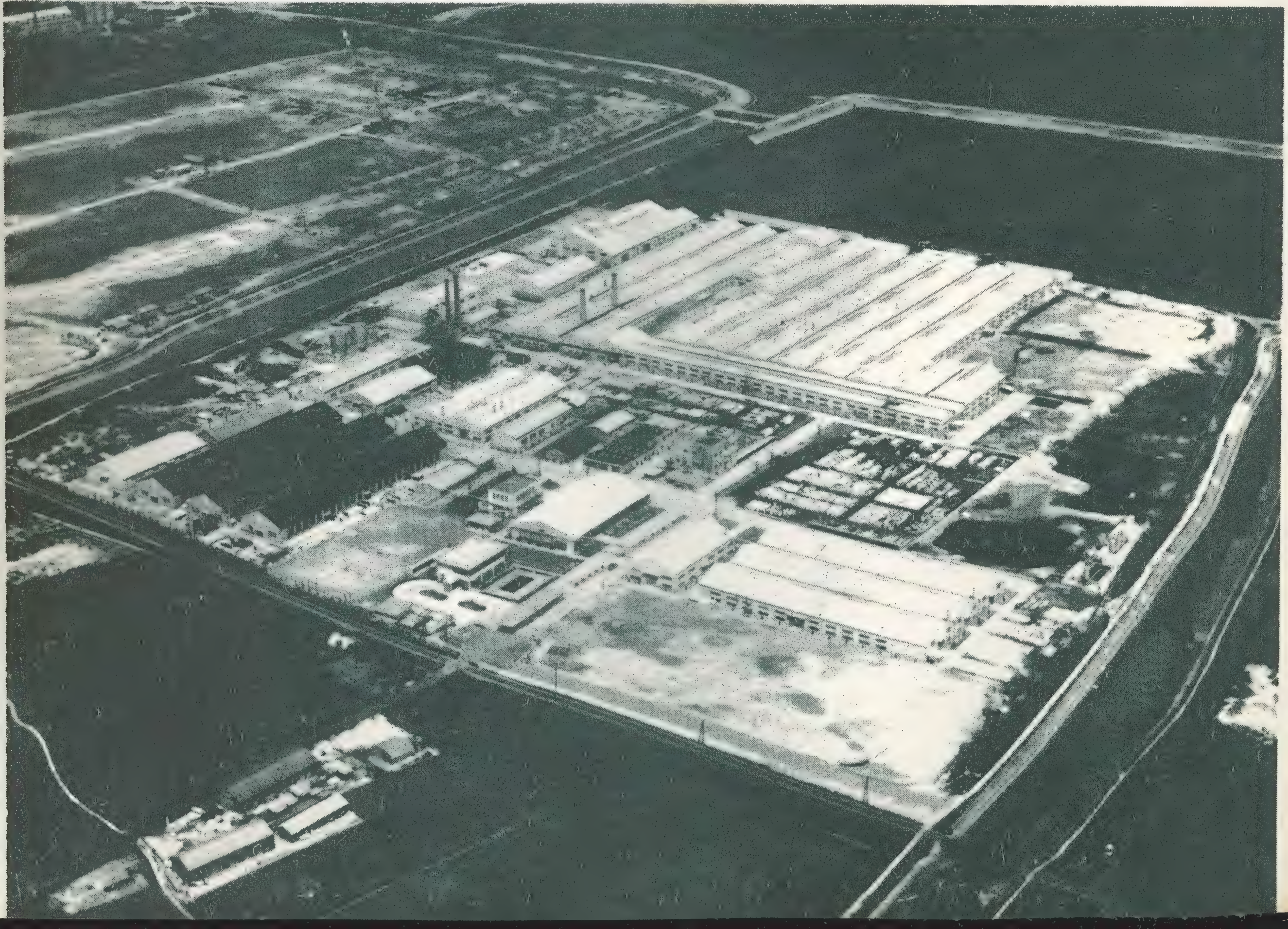
The plant at Chita was built in 1942 and extended in 1961 and again in 1966-67. Production at Chita centers on apparatus insulators and bushing shells. Normal production is limited to insulators of five meters in height, but the plant has produced insulators as tall as eight meters. Special features of the production processes used at Chita include:

- "green" trimming
- drying by electric current.

This plant is also used for the manufacture of chemical machinery. Factory employees number 985 at Chita which also employs 198 office workers. (See Figure 2a.)

Figure 2, above: Foreground, Mizuho factory and NGK head office; background, Atsuta factory, NGK

Figure 2A, below: Chita factory, NGK



Komaki

NGK's newest plant, at Komaki, handles the production of standard and fog type suspension insulators, plastic insulators, and special ceramic products. It also houses NGK's new high voltage laboratory. This plant gives a good indication of NGK's desire to be as efficient as possible. They have not hesitated in using capital in place of labor whenever they felt the exchange would increase quality or help standardize their product. This has included replacing both high skilled and low skilled workers by machinery.

The plant at Komaki is of special interest because it was just modified so as to supply increased demand in the export market with suspension insulators.

Komaki was originally brought on stream in 1962. Several expansions have followed; the most significant was completed in May of 1967. (See Figure 2b.) All of these additions were to suspension insulator capacity. Future additions are slated for post-type insulators. Details were disclosed November, 1967 — a technical article in Japanese quoted NGK officials:

> ... Despite the completion of the secondary construction of Komaki Factory, ... production is still unable to keep up with orders. In export sales, especially, the term of delivery is being prolonged and new orders are being held off.
>
> Reinforcement of the production force was therefore planned by means of the facility increase. A site of 23,100 square meters (248,648 square feet) in Komaki Factory was appropriated for the construction of the new factory. The factory will specialize in station post insulators, because "the share of this type of insulators in the insulator demand both in domestic and export markets is expanding, and concentrated production method, not only a production increase, must be tried so as to improve management and lower the cost for more intensified competitive capacity in the international market."

Figure 2B: Komaki factory and high voltage research laboratory, NGK

The new factory (really an addition at Komaki) is to be completed by June 1968. Production capacity will be about $475,000 per month, an increase of about 10 percent for the company as a whole. Additions are also slated for the extra high voltage lab at Komaki as well as to resin insulator capacity there. Both will be discussed below.

Currently, production is centered around 15,000 and 25,000 pound suspension insulators.

The Komaki plant produces the porcelain shell and does the assembly. The hardware components are brought from another NGK plant — some are purchased from NGK subsidiaries.

Plant capacity is 600,000 pieces per month; capacity utilization in September 1967 was 85 percent or 510,000 pieces per month. Over 80 percent of this plant's production is exported — mostly to the United States. According to the plant's manager, Mr. T. Niki, 604 employees are allocated for this production.

Before Komaki was opened, similar production required twice as many personnel. Mr. Niki expects to reduce labor by another one-half within the next five years.

NGK PRODUCTION PROCESSES AND COSTS

The provisions of the Anti-Dumping Act, 1921, provide for three measures of fair value. Although the Treasury Department decides which is most appropriate, an analysis of NGK sales was conducted along two lines.[1] One of the measures of dumping is based on the constructed value of the commodity in question. According to Section 206(a) of the Act:

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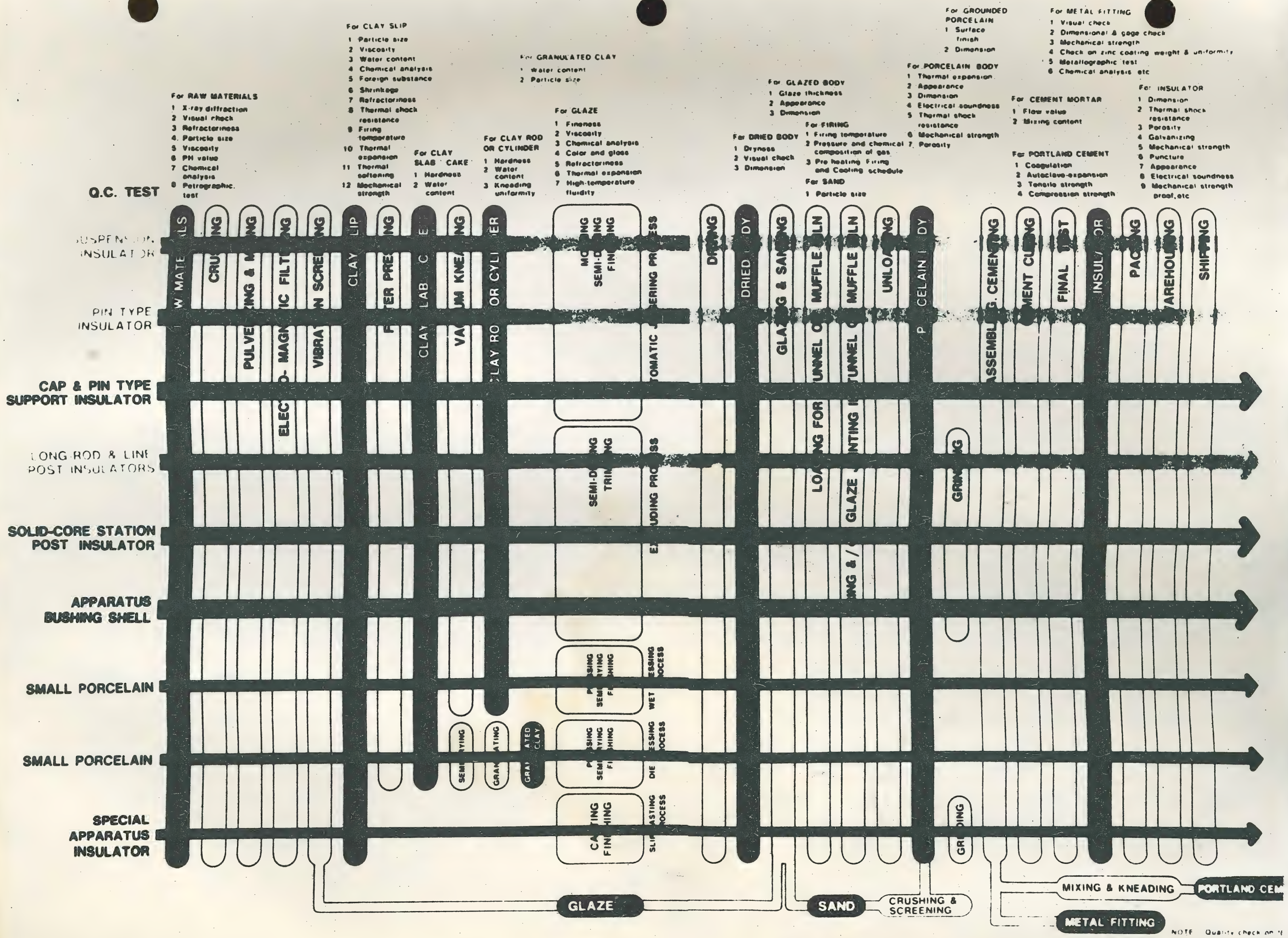
[1] See p. 107.



Q.C. TEST
For RAW MATERIALS
1 X-ray diffraction
2 Visual check
3 Refractoriness
4 Particle size
5 Viscosity
6 PH value
7 Chemical analysis
8 Petrographic test
For CLAY SLIP
1 Particle size
2 Viscosity
3 Water content
4 Chemical analysis
5 Foreign substance
6 Shrinkage
7 Refractoriness
8 Thermal shock resistance
9 Firing temperature
10 Thermal expansion
11 Thermal softening
12 Mechanical strength
For CLAY SLAB CAKE
1 Hardness
2 Water content
For CLAY ROD OR CYLINDER
1 Hardness
2 Water content
3 Kneading uniformity
For GRANULATED CLAY
1 Water content
2 Particle size
For GLAZE
1 Fineness
2 Viscosity
3 Chemical analysis
4 Color and gloss
5 Refractoriness
6 Thermal expansion
7 High-temperature fluidity
For DRIED BODY
1 Dryness
2 Visual check
3 Dimension
For GLAZED BODY
1 Glaze thickness
2 Appearance
3 Dimension
For FIRING
1 Firing temperature
2 Pressure and chemical composition of gas
3 Pre heating Firing and Cooling schedule
For SAND
1 Particle size
For PORCELAIN BODY
1 Thermal expansion
2 Appearance
3 Dimension
4 Electrical soundness
5 Thermal shock resistance
6 Mechanical strength
7 Porosity
For GROUNDED PORCELAIN
1 Surface finish
2 Dimension
For CEMENT MORTAR
1 Flow value
2 Mixing content
For PORTLAND CEMENT
1 Coagulation
2 Autoclave-expansion
3 Tensile strength
4 Compression strength
For METAL FITTING
1 Visual check
2 Dimensional & gage check
3 Mechanical strength
4 Check on zinc coating weight & uniformity
5 Metallographic test
6 Chemical analysis etc
For INSULATOR
1 Dimension
2 Thermal shock resistance
3 Porosity
4 Galvanizing
5 Mechanical strength
6 Puncture
7 Appearance
8 Electrical soundness
9 Mechanical strength proof, etc
INSULATOR
PIN TYPE INSULATOR
CAP & PIN TYPE SUPPORT INSULATOR
LONG ROD & LINE POST INSULATORS
SOLID-CORE STATION POST INSULATOR
APPARATUS BUSHING SHELL
SMALL PORCELAIN
SMALL PORCELAIN
SPECIAL APPARATUS INSULATOR
CRUSHING
ELECTRO- MAGNETIC FILTERING
VIBRATION SCREENING
CLAY SLIP
FILTER PRESSING
VACUUM KNEADING
CLAY ROD OR CYLINDER
SEMI-DRYING
TRIMMING
EXTRUDING PROCESS
WET PRESSING PROCESS
DIE PRESSING PROCESS
PRESSING
SEMI-DRYING
FINISHING
SLIP CASTING PROCESS
CASTING
FINISHING
DRYING
DRIED BODY
GLAZING & SANDING
LOADING FOR TUNNEL OR MUFFLE KILN
GLAZE JOINTING IN TUNNEL OR MUFFLE KILN
UNLOADING
PORCELAIN BODY
GRINDING
ASSEMBLING, CEMENTING
CEMENT CURING
FINAL TEST
INSULATOR
PACKING
WAREHOUSING
SHIPPING
GLAZE
SAND
CRUSHING & SCREENING
MIXING & KNEADING
METAL FITTING
NOTE Quality check on

...the constructed value of imported merchandise shall be the sum of —

(1) the cost of materials...

(2) an amount for general expenses and profit...

(3) the cost of all containers...and all other expenses (to prepare)...the merchandise... for shipment to the U. S.

Since the Komaki plant is geared primarily to the manufacture of suspension insulators, it is appropriate to analyze closely the production processes and costs incurred at this plant and to induce from those costs a fair value price. The analysis begins with a description of Komaki' s operation and then proceeds to an analysis of labor cost, raw material costs, total production costs and profits.

Raw Materials Handling

The most mechanized part of NGK suspension insulator production is the preparation of body materials. Raw materials are received in bulk state. Each shipment is classified according to point of origin and grade, and stored in separate outdoor bins, shown in Figure 3.

The raw materials are transported from the storage bins by bulldozers (Figure 4) that dump them into large crushers or " Impeller breakers." NGK' s Komaki plant has two of these crushers, each capable of handling three tons of raw material per hour. Crushing is done on a batch basis; each batch contains raw material from several shipments, measured to achieve body consistency. These materials go through a cycle of crushing and gravity screening until they form a coarse-grained powder. The heat generated by crushing dries the raw materials. The powdered materials are stored in silos. Weigh cars, suspended

Figure 3: Raw material storage, Komaki factory, NGK

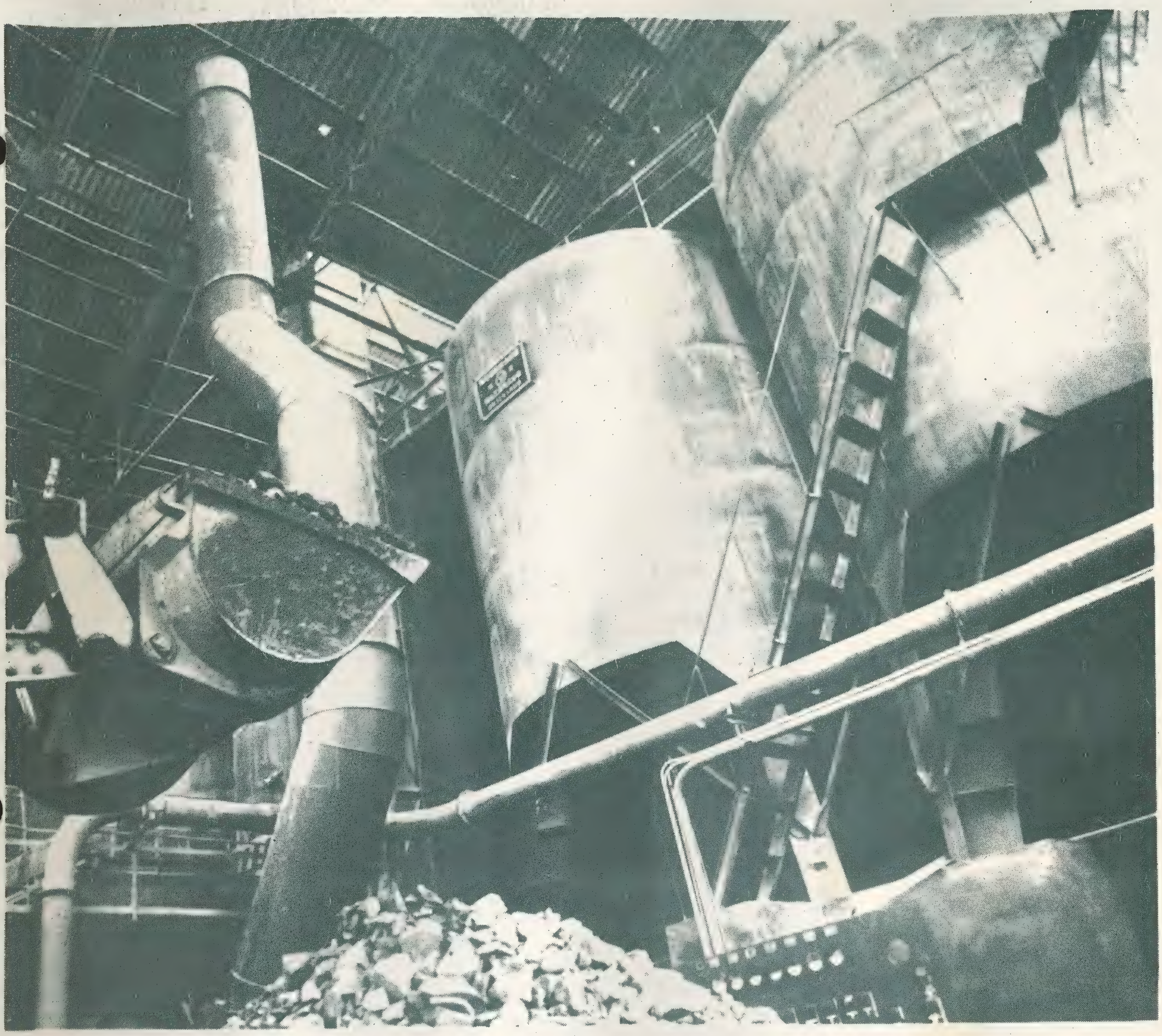
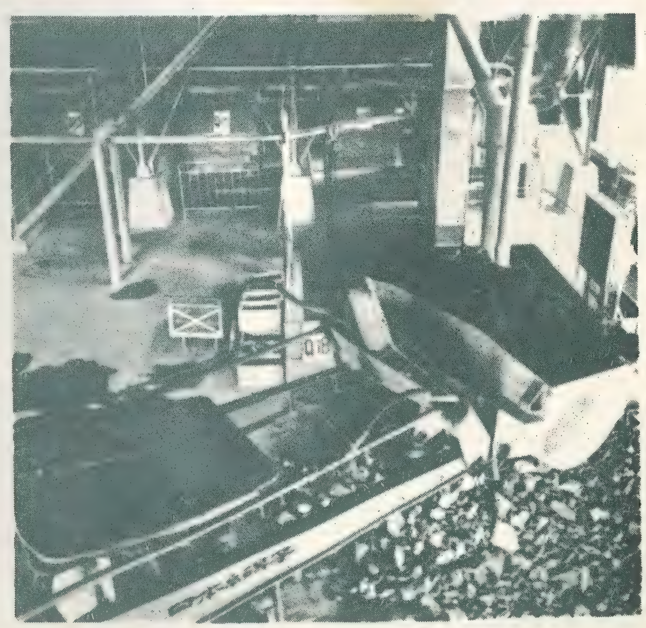


Figure 4: "Impeller" breakers,
Komaki factory, NGK



from overhead tracks, collect materials from each silo to create a further balancing in the body materials. The filled weigh cars are moved along tracks by hand to an underground complex of ball mills (Figure 5) where the materials are blended with clay and water and the entire mixture is pulverized and blended into clay slip. The slip is pumped from the ball mills through electromagnetic filters (Figure 6) and vibrating screens (Figure 7) to remove any remaining ferrous particles or oversized particles. The filtered slip is stored in large agitating tanks from which it is fed to the filter presses.

At Komaki, NGK has installed two crushers and two lines of ball mills, filters and agitators. One crusher handles the raw materials for NGK's regular suspension insulators. The other handles raw materials for the high alumina content body. The entire body preparation section is operated one shift per day, six days a week. The crushers are operated even less.

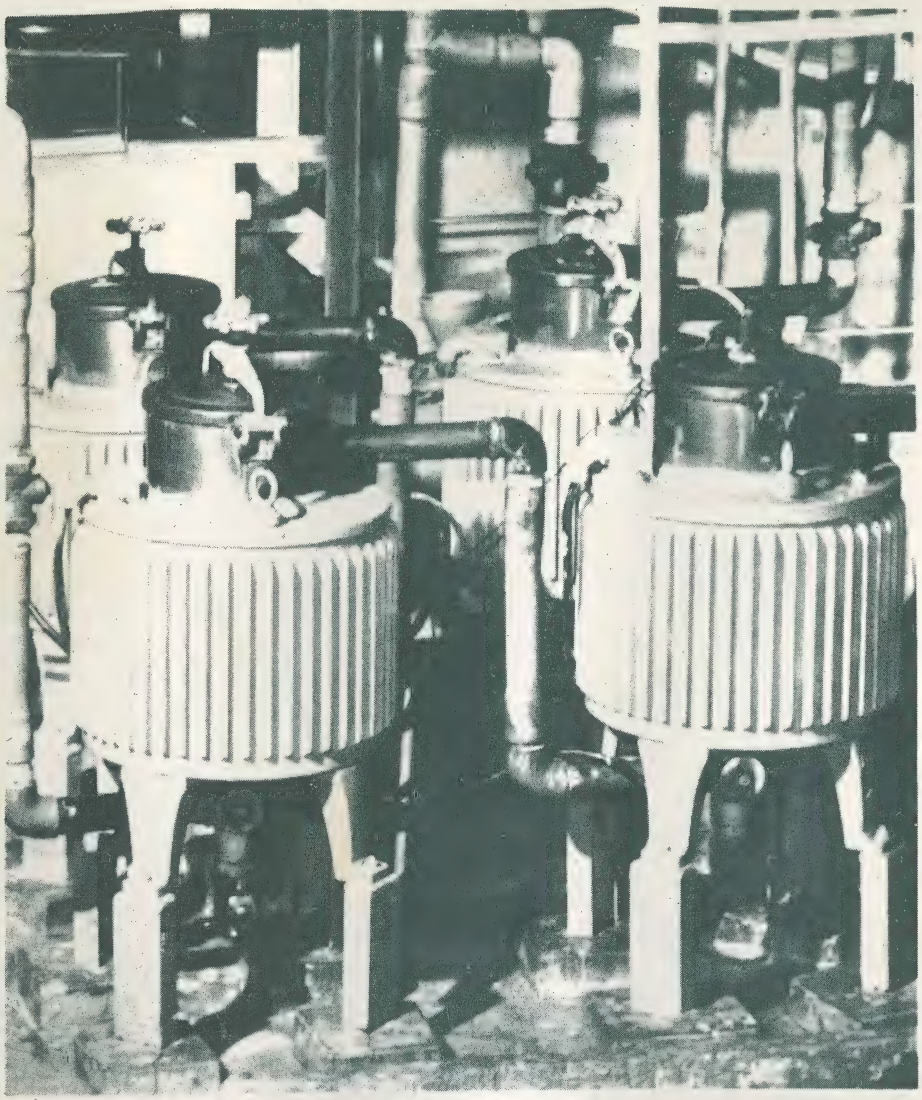
Very few employees are needed to handle NGK's raw materials. During our plant visit we saw only four employees in the area, two of whom were washing down the machinery and floors. Although the body preparation equipment is efficient in terms of labor cost, its current capital costs are high due to high interest rates in Japan.

Forming Suspension Insulator

The filter-pressed cake is moved by hand truck to a de-airing vacuum pug mill. The pug mills are loaded and unloaded by hand. The extruded cylinder, about 8 inches by 36 inches, is brought to the three-step forming operation. First,

Figure 5: Ball mills, Komaki factory. NGK

Figure 6: Electro-magnetic filters, Komaki factory, NGK



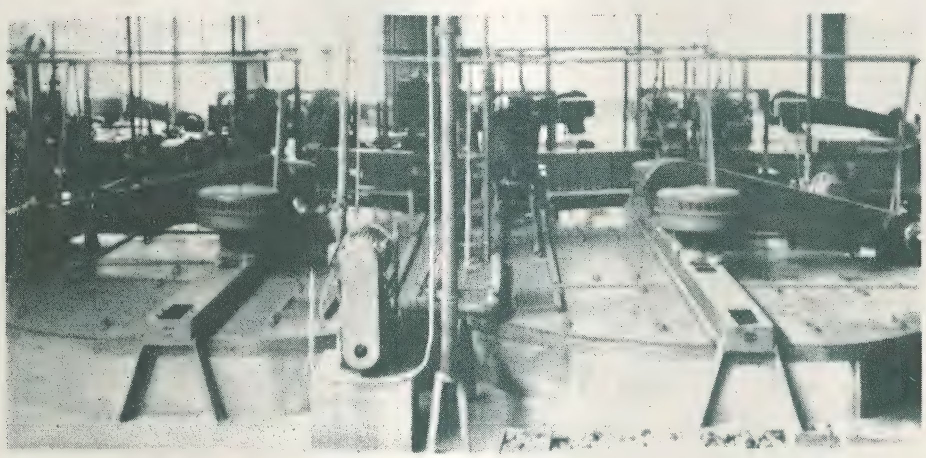


Figure 7: Agitator tanks for storage of slip, Komaki factory, NGK

the cylinder is cut into three pieces, each about ten inches long. These pieces are hand kneaded into the shape of a bullet. Second, the kneaded piece is put on a potter's wheel and the general form of the cap is hand turned. This hand turned "billet" is then placed into a plaster mold, which moves along a conveyer belt to an "automatic jiggering machine." Rotating metal dies press the face of the insulator in three steps. (See Figures 8 and 8a.) The dies did not appear to be heated, certainly not by a gas flame as is usual in U. S. factories. Each piece is lubricated as it turns, however, and an occasional wisp of smoke is observable. This may be due either to an electrical heating device or to heat generated by turning and pressing the clay. (The machine turns out 3-1/2 to 4 insulators per minute and is operated by a six-man crew.) The assignment of the six men is as follows:

- Two men cut the cylinders to size and hand knead them to bullet shape.
- Two men form the cap of the insulator on potter's wheels. One man watches the conveyor, and with a vacuum hose, cleans the molds before the formed clay is placed in them.
- One man watches the machine and makes certain the molds are properly set on the conveyor as they leave the jiggering machine.

The formed insulator is carried by conveyor (Figure 9) to a mold release dryer, which brings the insulator to $40^{O}C$ ($104^{O}F$) for about two hours. The insulator is automatically removed from its mold (Figure 10) and allowed to dry for an additional hour. Drying is done face up.

At the end of this preliminary drying, the insulator's moisture has been reduced 2 or 3 percent, to about 23 percent. The insulator is removed

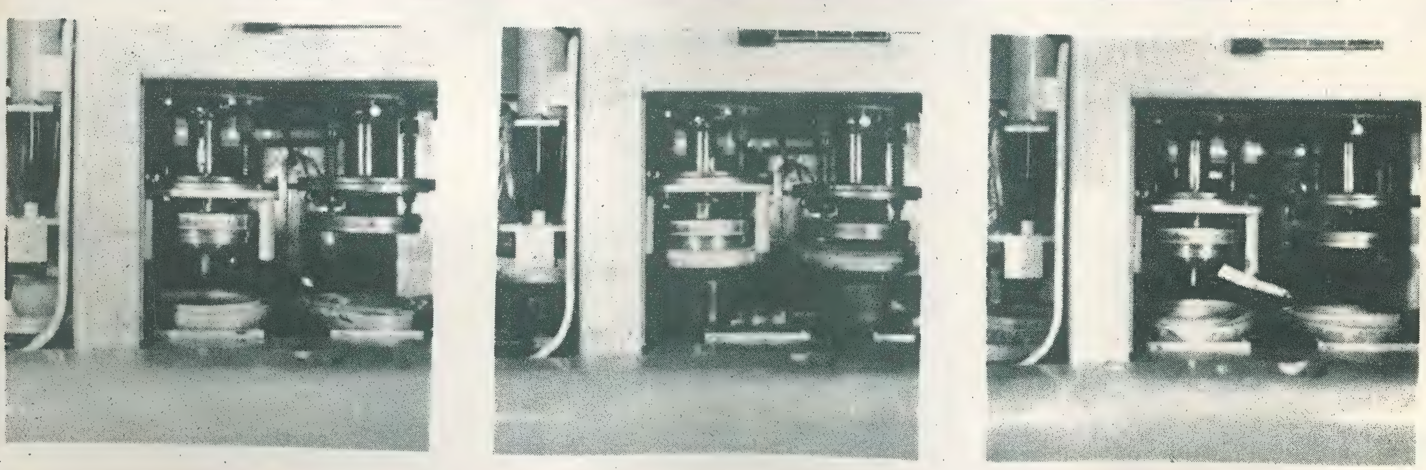


Figure 8: Automatic jiggering machine for suspension insulators, Komaki factory, NGK

Figure 8A: Detail of jiggering machine showing 3 step forming of suspension insulator face

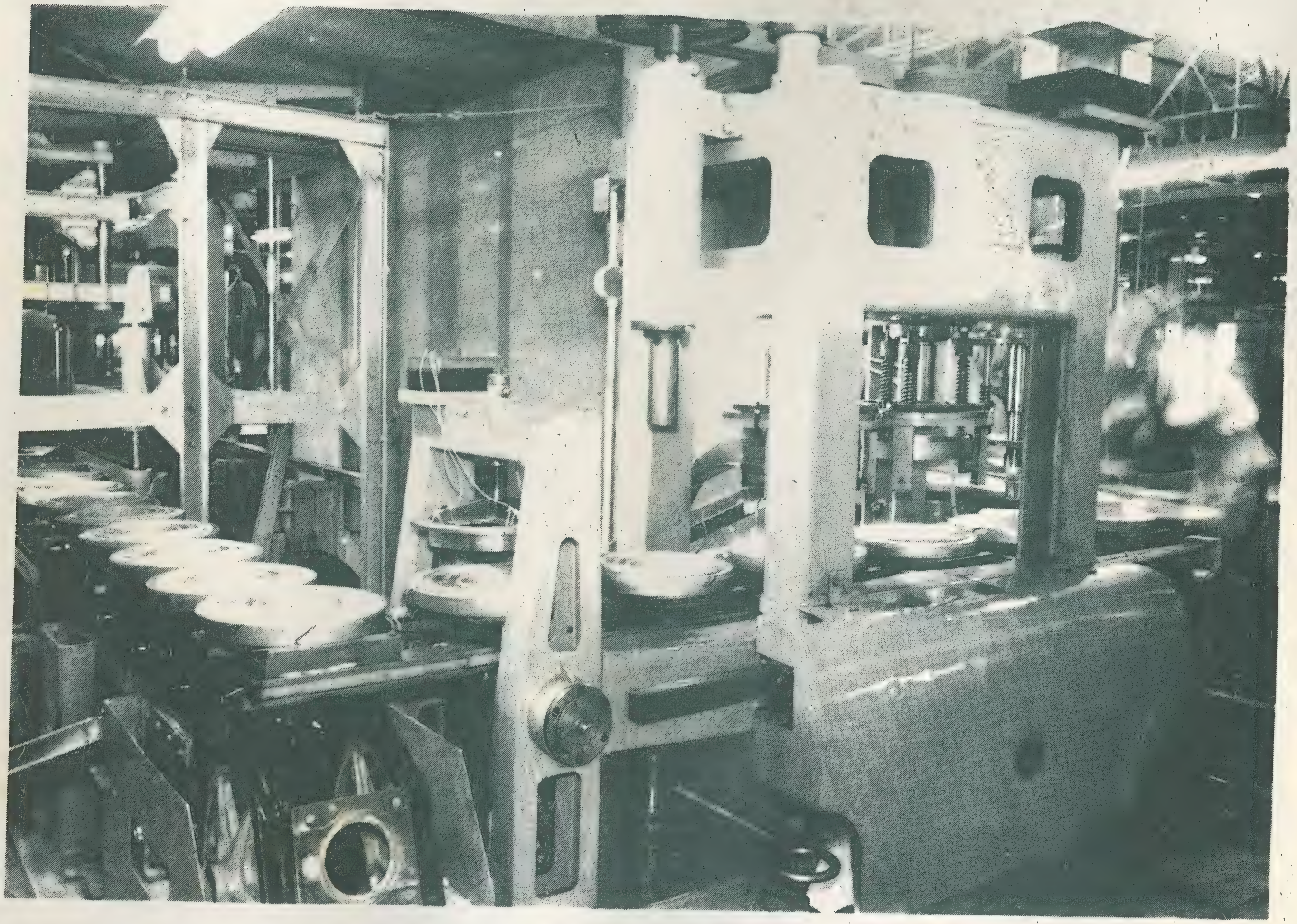


Figure 9: Formed suspension insulator shells being conveyed to mold release dryer, Komaki factory, NGK

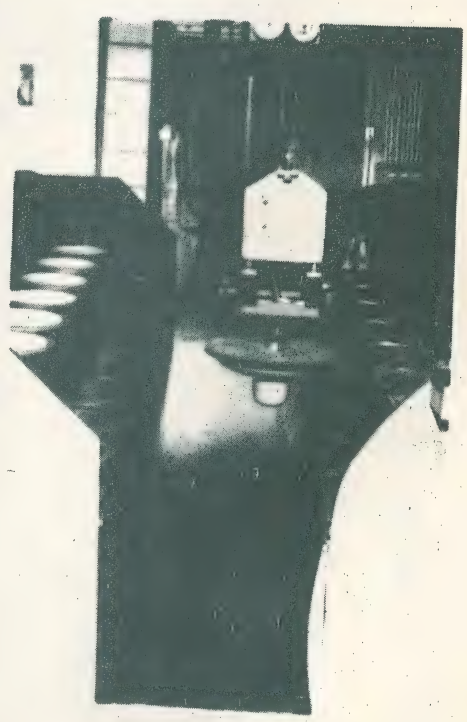


Figure 10: Suspension insulator shells automatically removed from molds, Komaki factory, NGK

from the dryer by hand and placed face down on a potter' s wheel for trimming and finishing. Only the head of the insulator needs trimming. This is done by a mounting knife so as to cut the head to proper height and diameter. Each head is checked for correctness by means of a hand held plastic template. A small piece of metal is then gently passed over the surface of the turning insulator to obtain a smooth surface. Three girls and one man operate as one finishing crew. Each crew services one dryer. Each girl finishes about 72 pieces per hour. The man' s function is to mark each piece with the name of the finisher and then load the insulators on hand trucks for drying.

NGK' s forming operation has significant opportunities for labor cost savings. For example, of the six men currently needed to supply the "automatic jiggering machine," the two assigned to watch the conveyor and machine do not serve any productive function and can be eliminated without any change in the process. The remaining four men can be eliminated as soon as NGK adapts its body materials or machine to permit forming the insulator from a less completely shaped piece of clay.

Similarly, the finishing operation can be mechanized to save on labor when it becomes necessary. The plant manager at Komaki, Mr. Niki, said he expected to reduce his work force by one-half within the next five years. The forming operation, he said, is already being studied. There seems to be no reason why he should not achieve his objective.

The forming and finishing operations are geared to operate at the same rate. Thus, it currently requires ten persons, six at the jiggering machine,

four at the finishing tables, to produce four pieces per minute. To produce 510,000 suspension insulators, the current monthly production requires ten crews of ten men, each working eight hours per day, six days per week. This rate of production is slower than the body preparation, glazing, and assembly operations, and it is necessary to operate the forming operations on a two shift per day basis, six days a week. All other plant operations, except of course the kilns, are operated one shift.

Drying

The next step in insulator production is drying. The finished "green" shell is placed onto a six-shelf metal truck that carries 72, ten-inch diameter insulator shells. The loaded trucks are pushed by hand into one end of a tunnel dryer. As other trucks are pushed in, the insulators move through the dryer and are removed by hand at the other end at the rate of five trucks every two hours. The shells are in the dryer for about ten hours at a maximum temperature of 60°C (140°F). Drying losses at Komaki are very high; NGK spokesman estimated them at 15 percent. Drying cracks and other visual imperfections are discovered by close inspection as the dried shells are unloaded from the trucks and put onto a conveyor belt.

Glazing and Sanding

The shells are removed from the conveyor belt and a pale pink liquid is poured into the head of the insulator. This liquid is absorbed into the body of the insulator head. The piece is replaced on the conveyor and carried to a

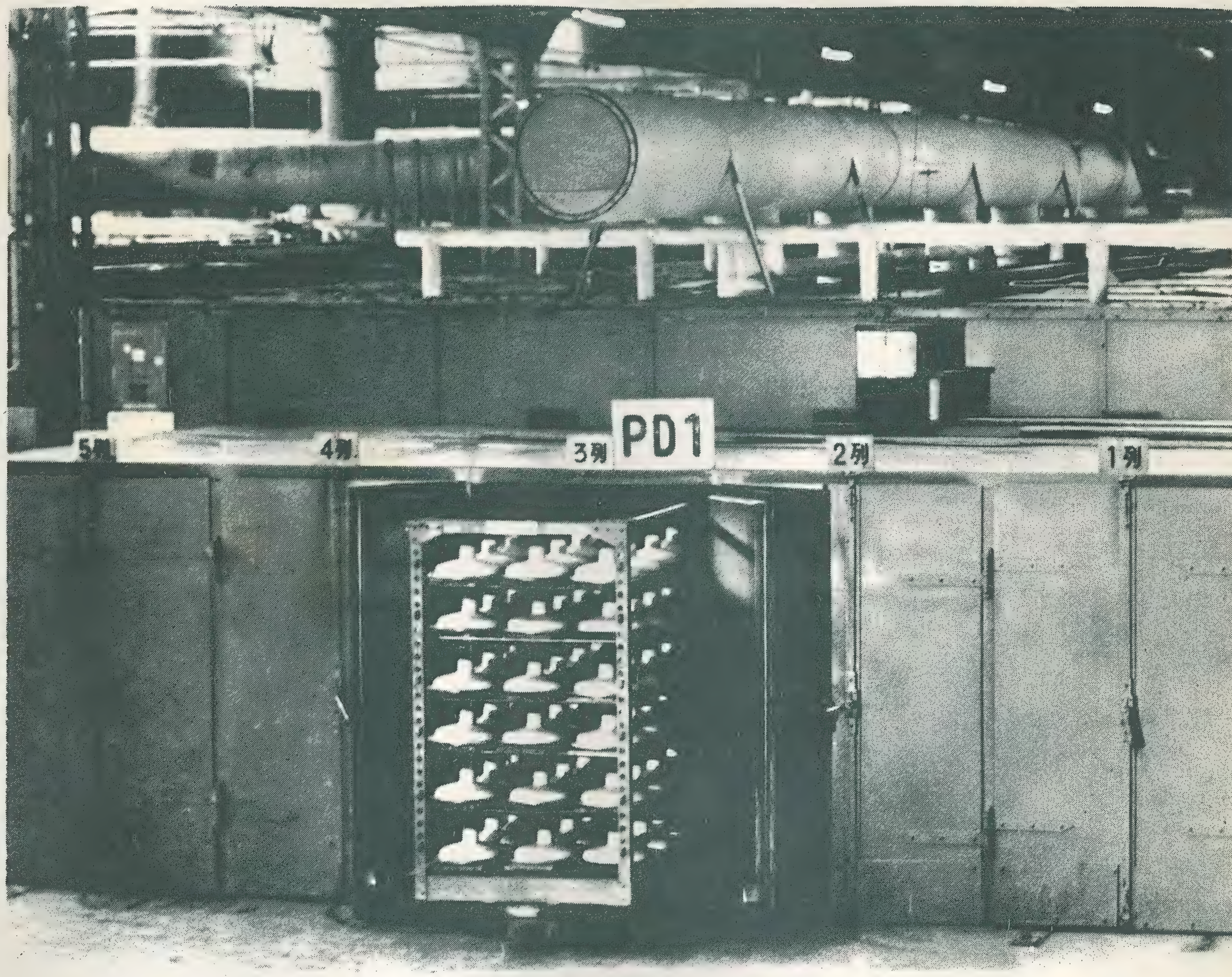


Figure 11: Dried insulator shells exiting from tunnel dryer, Komaki factory, NGK

glaze booth in which the glaze is flowed on. Sand is then applied to the inside and outside of the insulator head.

The Komaki plant has several glazing stations. At all except one station, the shell must be hand lifted three times: (1) from the conveyor into the glaze booth, (2) out of the glaze booth for sanding, and (3) back onto the conveyor after sanding. The adhesive for the sand is put on by a hand held brush. The sand itself is blown on. In the one station that is different, this process has been mechanized. The shell is taken from the conveyor, and glazed and sanded automatically. Significantly, however, the same number of people work at the automatic stations as at the other stations. Unless the outputs of the stations differ significantly, it is likely that NGK has increased its capital costs without decreasing its labor costs.

The glazed and sanded shells are individually placed face down on an overhead conveyor. As the conveyor moves along, the NGK stencil is marked on the back of the shell. A girl wets a section of the insulator with a sponge and then applies the stencil with what looks like an ordinary rubber stamp. The insulators continue along the conveyor to the kilns.

Firing

NGK's plant at Komaki is equipped with the two longest tunnel kilns in Japan. Each kiln measures 140 meters long and has a 70-car capacity. The insulator shells are fired in a reducing atmosphere at a maximum temperature

of 1380^{o}C (2516^{o}F). The firing cycle is 72 hours. The fuel used in the kilns is a light grade fuel oil with sulphur content of less than .05 percent by weight. NGK has developed a glaze which is unaffected by firing with oil and they are able to use open shelf cars in the kilns.

The insulator shells are loaded directly from the conveyor onto kiln cars (Figure 12). These cars are stored on tracks next to the kilns as they wait to enter the kiln (Figure 13). Using kiln cars for storage involves higher capital costs than using lighter, less expensive, trucks for storage. But it eliminates the labor of loading and unloading the insulators from the conveyor to the storage carts and from those carts to the kiln cars.

It is commonly believed that low labor rates provide the Japanese with their greatest manufacturing advantage. Yet, NGK has consistently chosen to adopt materials handling systems that are more capital intensive than labor intensive. Indeed, the materials handling function at NGK is highly efficient. As the fired insulator exits from the kiln, it is visually inspected and replaced on the conveyor system for movement to the testing and assembly areas.

Testing and Assembling

The fired insulator shell is conveyed to a thermal shock test; the shell is plunged into water at 10^{o}C (50^{o}F) and again at 100^{o}C (212^{o}F) (Figure 16). After this test it continues along the conveyor to assembly. NGK did not allow close observation of its assembly area. The reason given was that they have certain secret machines which they do not want seen. The entire assembly

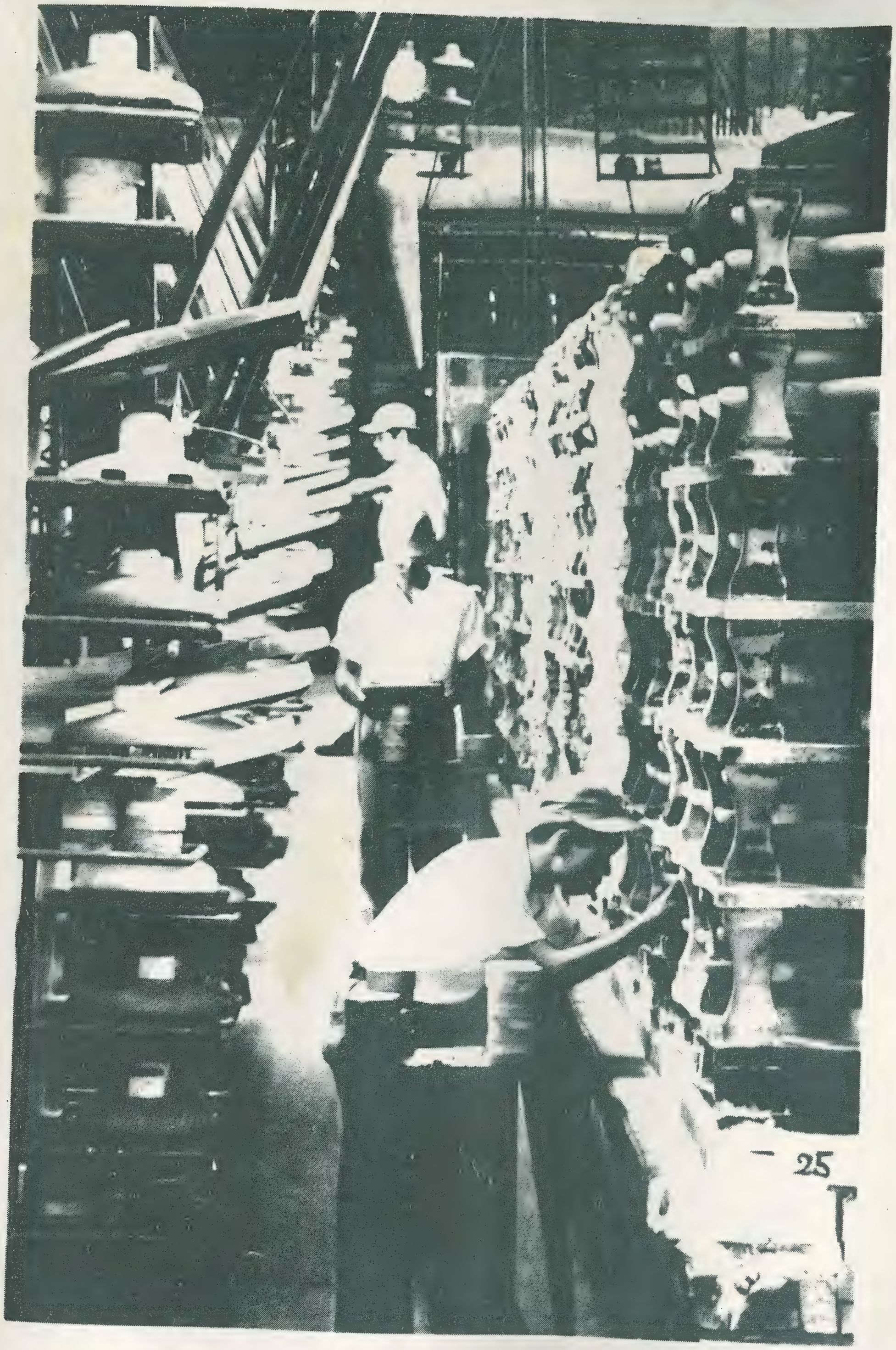


Figure 12: Kiln car being loaded direct from conveyor system

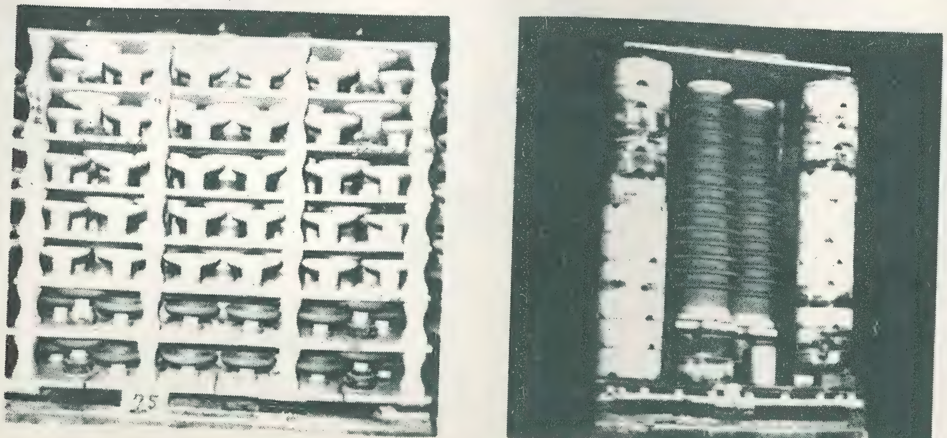
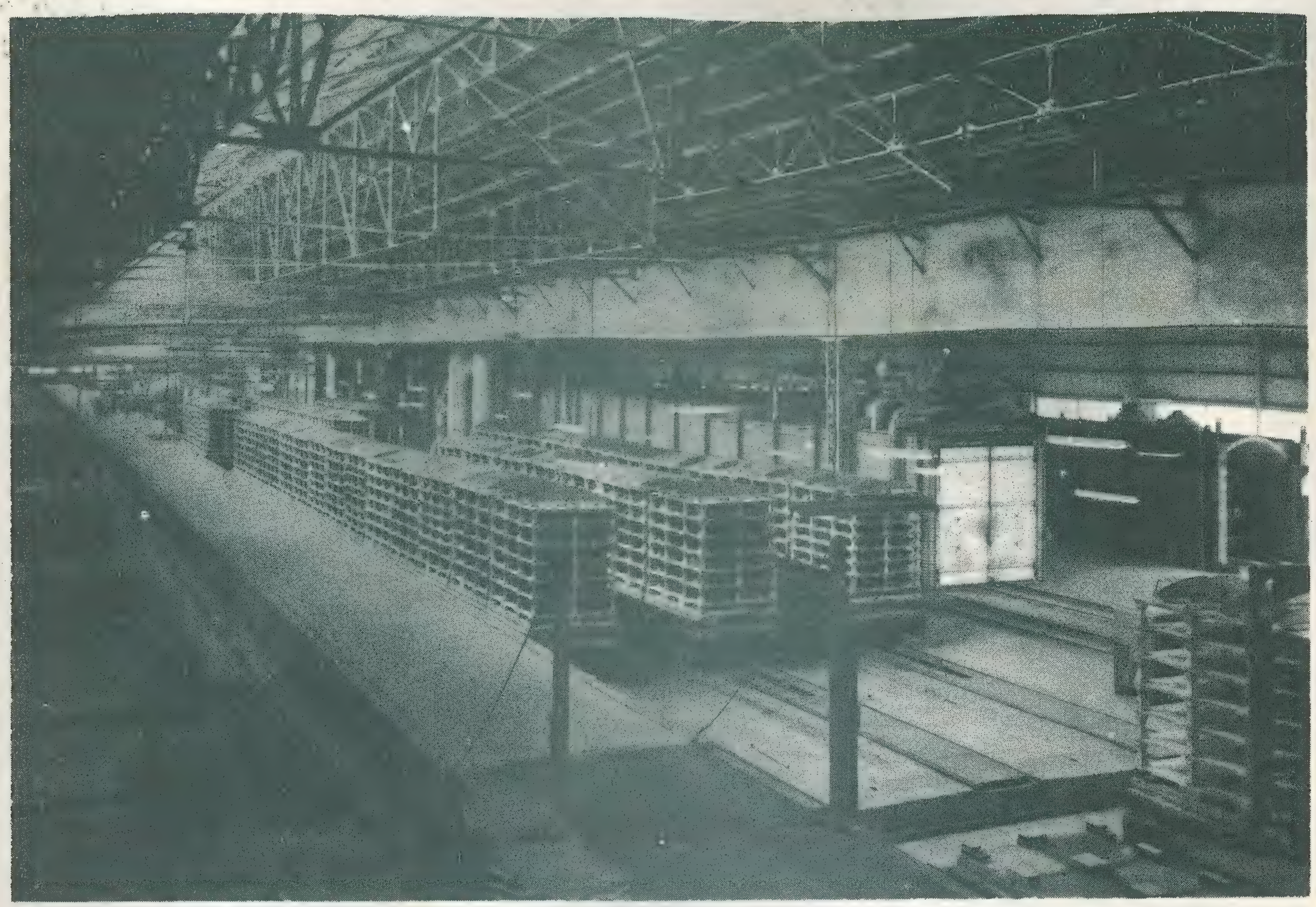


Figure 13: Loaded kiln cars



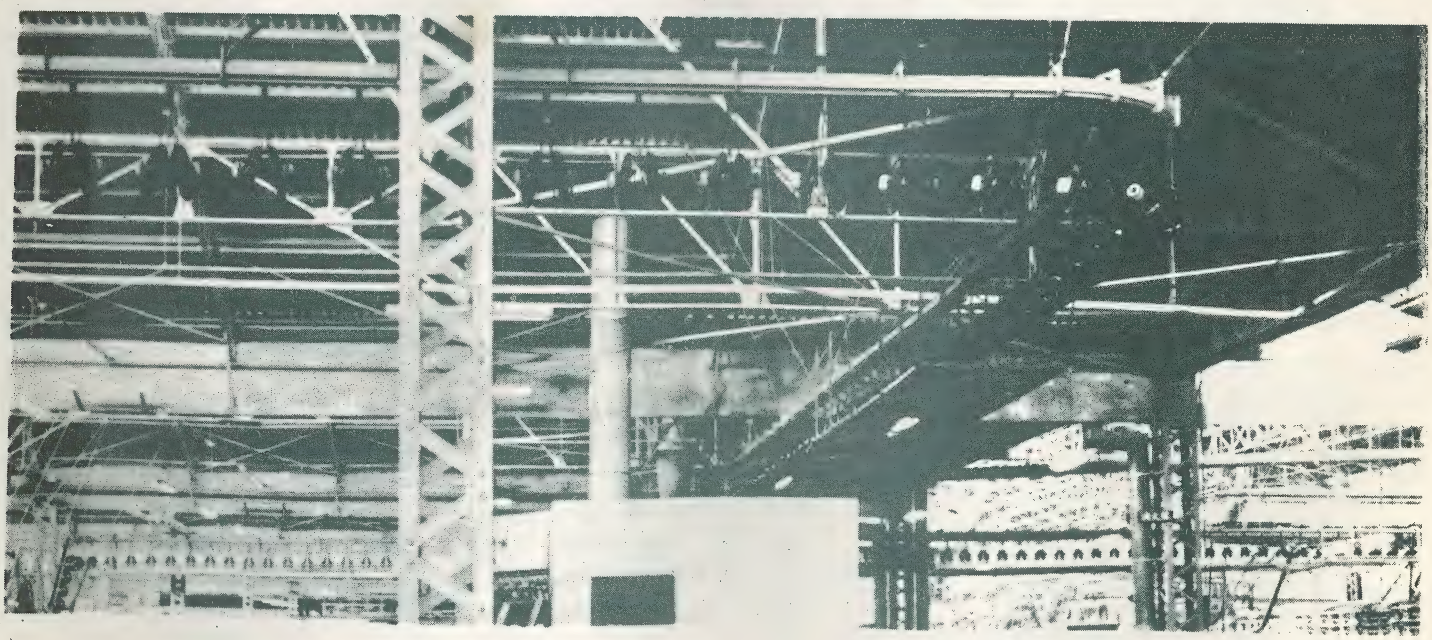


Figure 14, top: Loaded cars are stored alongside tunnel kilns, Komaki factory, NGK

Figure 15: Fired shells are reloaded onto extensive conveyor system for testing and assembly, Komaki factory, NGK

operation takes place on the conveyor system (Figure 17). The metal cap of the insulator is on the conveyor with its hole pointing up. It goes under a box-like shape on the conveyor system, where cement is probably applied in a measured amount. NGK uses a portland cement combined with silica sand as an aggregate. The cement used has a linear exponential coefficient of less than .03 percent. A worker then sets the porcelain shell into a metal cap, and both the head and cap pass under another box-like shape. Again, the function of this machine is probably to insert cement, since when the assembly emerges, another worker inserts the pin and the assembled insulator then goes into a precuring steam elevator through which it is removed. It is then placed in controlled steam chambers for two to three days of final curing. These are underground.

As each assembled insulator is removed from the curing chambers, it is subjected to routine electrical flashover and mechanical tensile strength (Figure 18) tests and also to visual inspection and dimensional checks. After these tests are completed, the insulators are returned to the conveyor system and taken to the packaging area.

Although the Japanese permitted a visit to only one plant, NGK officials did provide limited information on production processes at other plants. This information confirmed and supplemented information already received from published sources. The following items are presented in summary form:

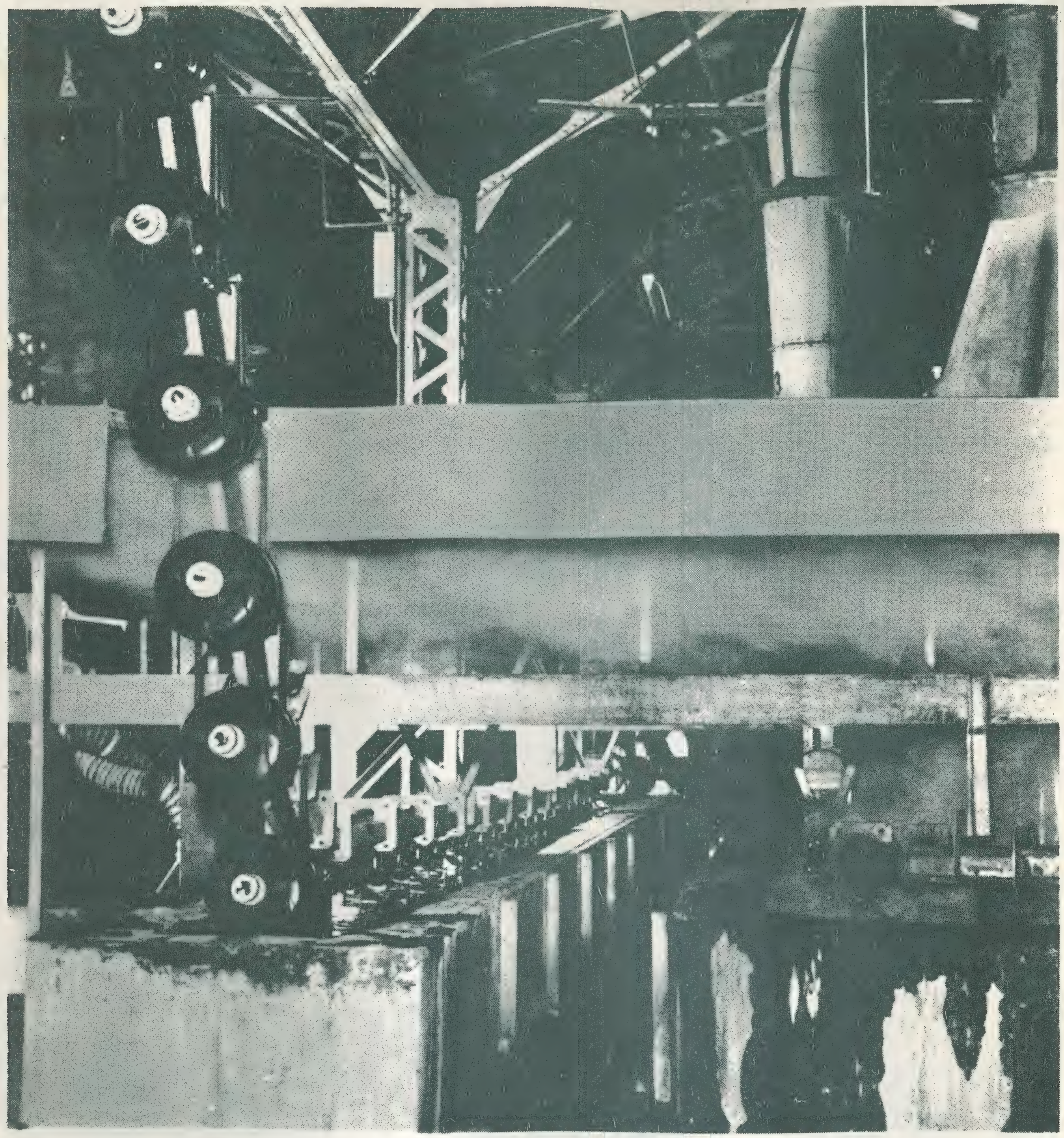


Figure 16: Thermal shock test. Left side of photograph shows 10°C bath. Right side shows 100°C bath, Komaki factory, NGK

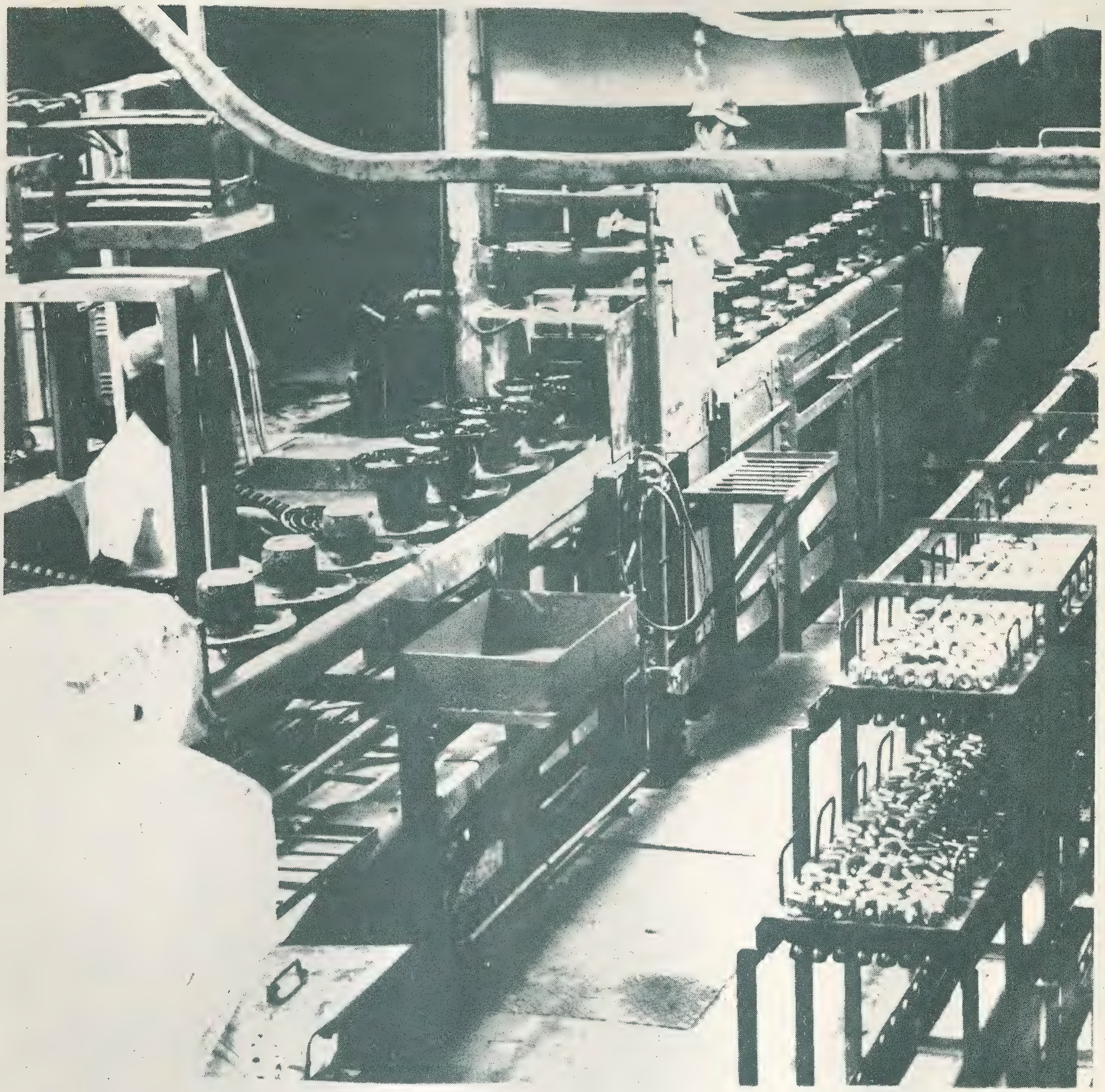


Figure 17: Assembly of NGK suspension insulators, Komaki, NGK

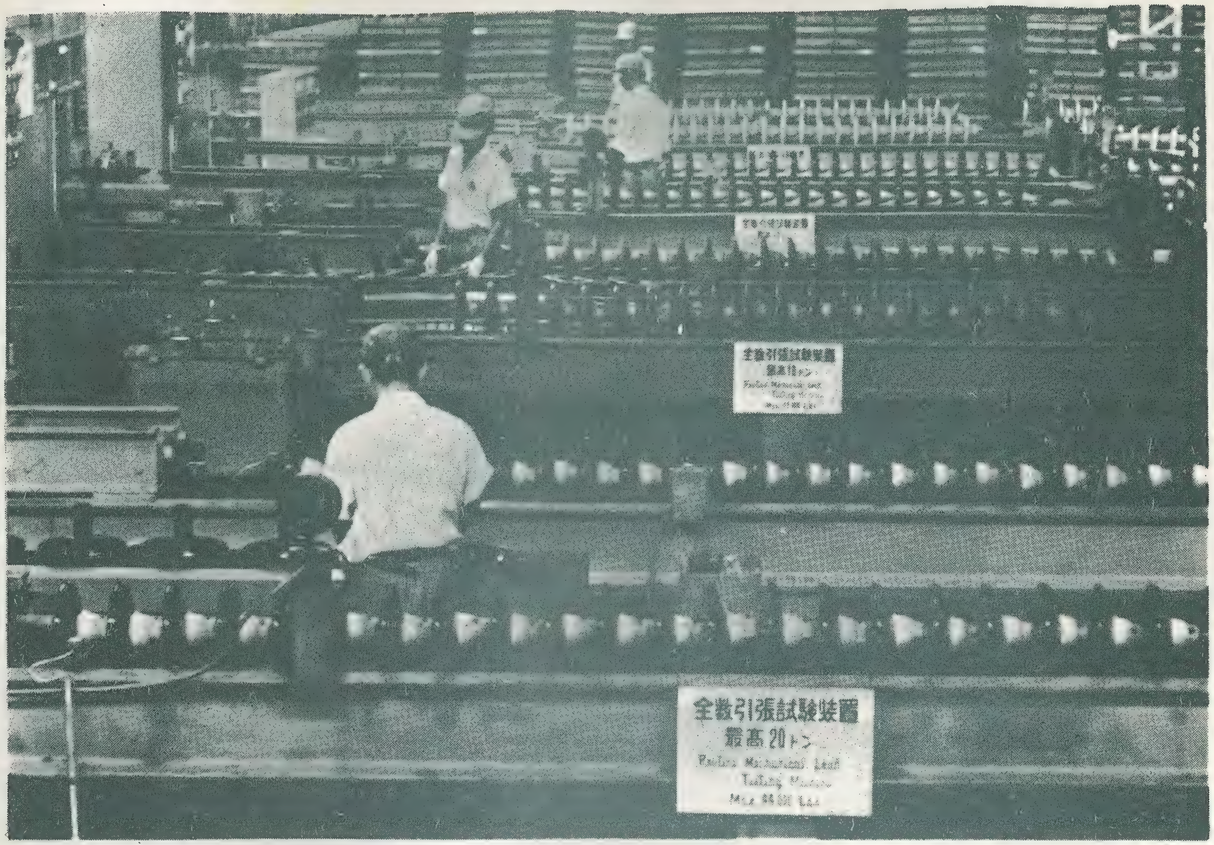


Figure 18: Mechanical pull test suspension insulators. Man in left foreground is setting up insulators for flashover test.

A. Forming

1. Cap and pin type insulators follow a production process very similar to that of suspension insulators, including forming of the insulators on "automatic jiggering machines." (Figure 19)

2. NGK now produces all its post type insulators, bushing and circuit breaker shells, from extruded blanks. Maximum diameter sizes produced by NGK were reported as 300 mm (12 inches) for solid core and over 1500 mm (60 inches) for cylinders with hollow centers (Figures 20 and 21). Normal production is limited to cylinders of 5 meters in height, although the largest porcelains NGK has produced have reached 8 meters in length. The extruded cylinder has about 25 percent moisture content. All insulators are green turned. Water content during green turning is 18 percent. Except for the smallest sizes, turning is done on vertical lathes which are hand operated (Figures 22-24). Until a few years ago, NGK used slip casting in plaster molds to produce its large pieces of porcelain. They have now moved away from that operation.

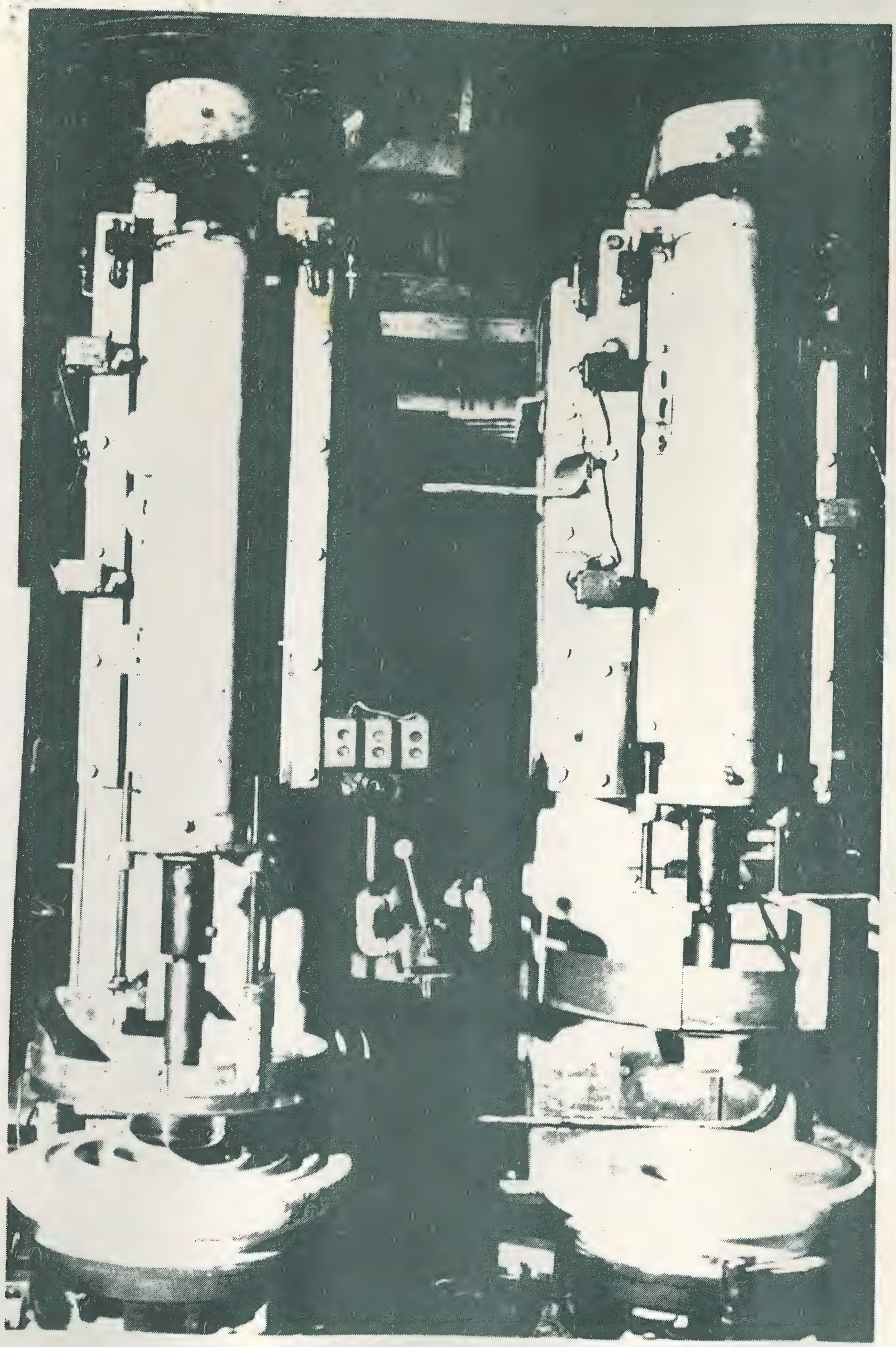


Figure 19: Automatic jiggering of cap and pin type insulators. Mizuho factory, NGK

Figure 20, right: Extruding large cylinders for bushing and circuit breaker shells, Chita factory, NGK

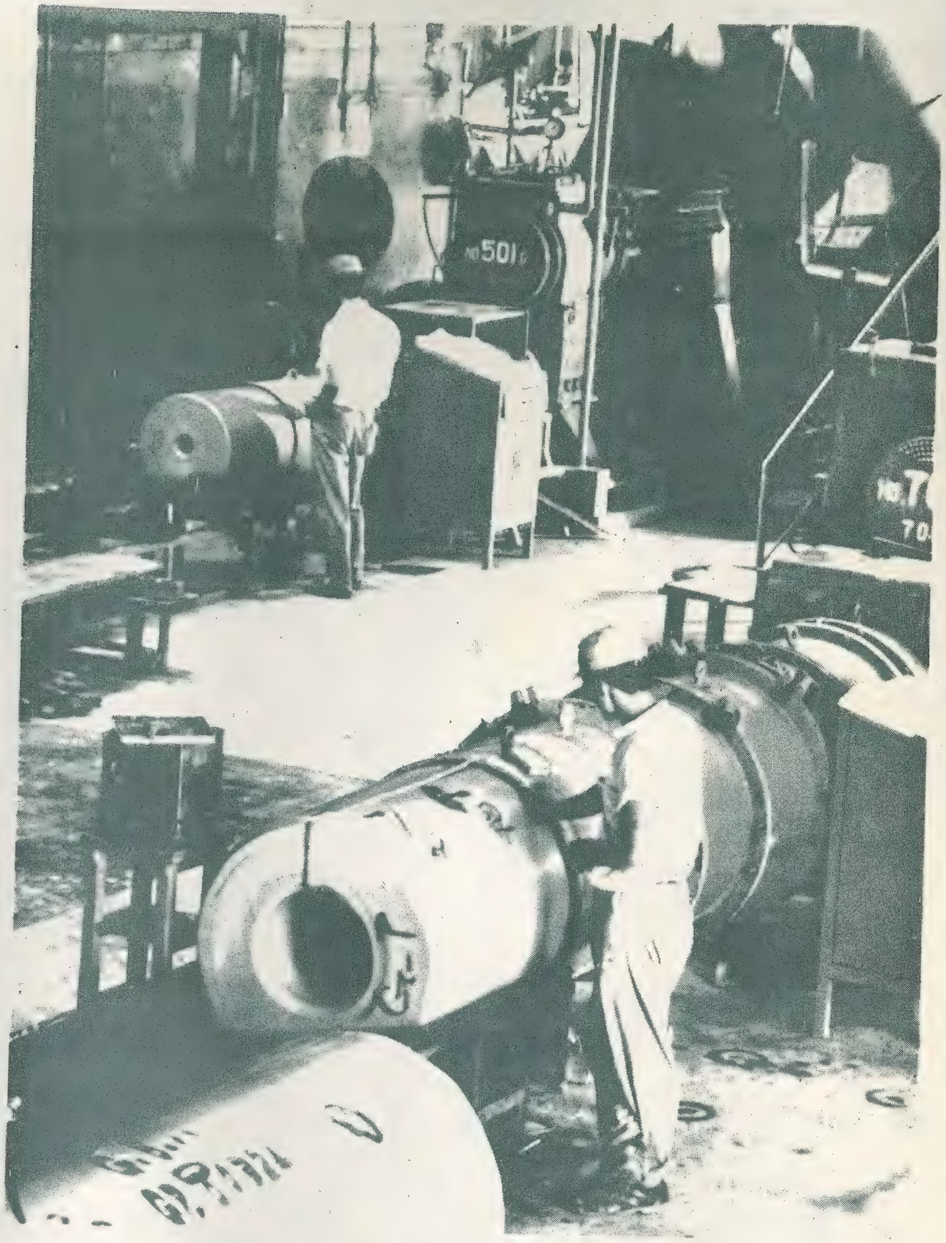
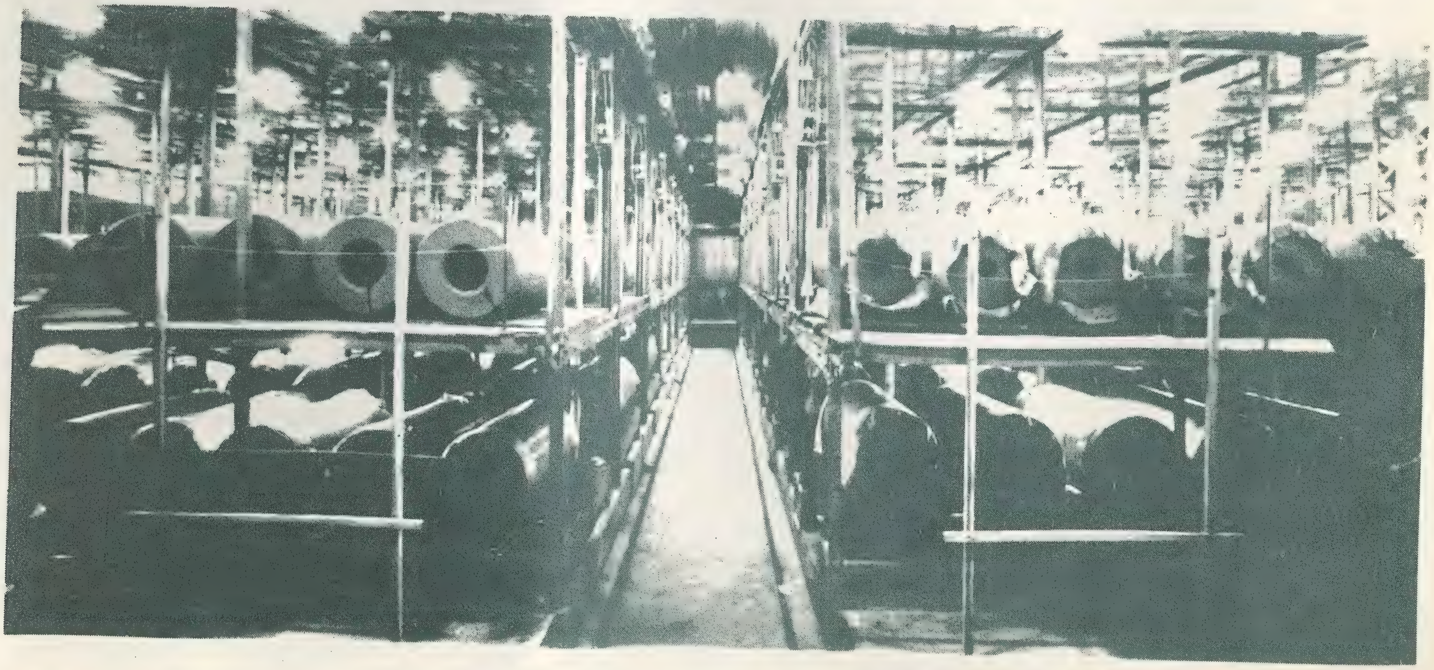


Figure 21, below: Semi-drying extruded cylinders before trimming, NGK



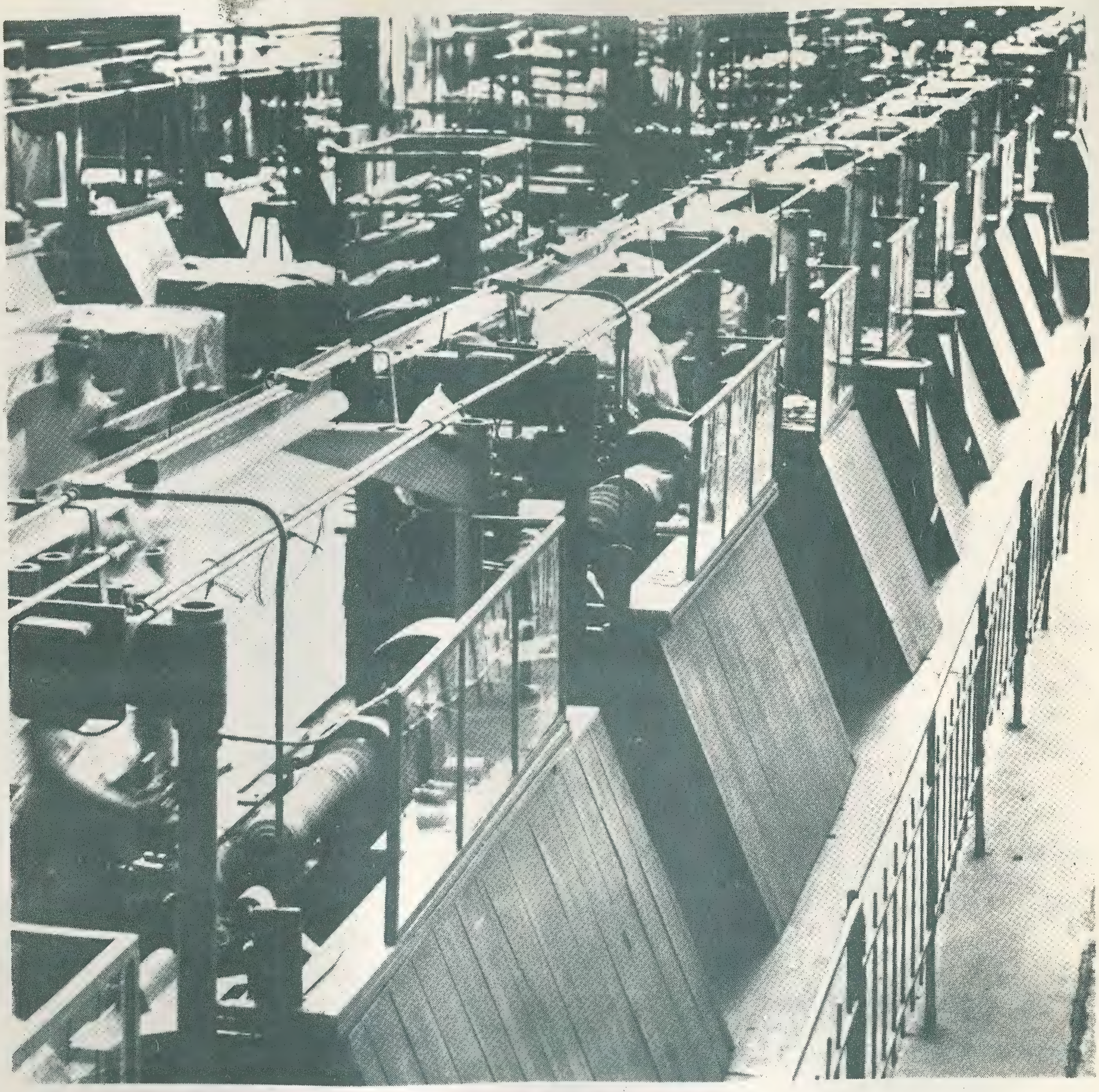
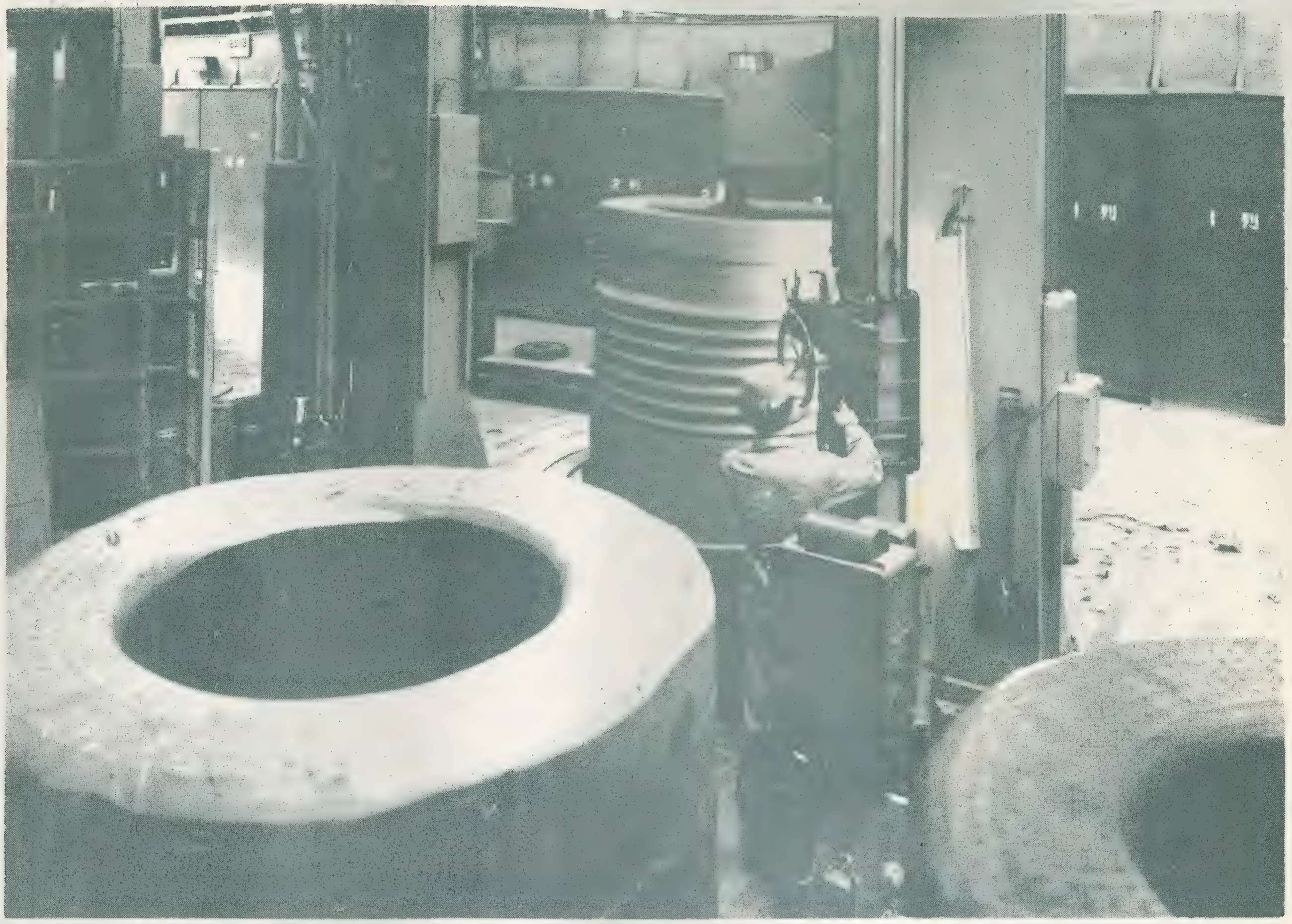


Figure 22: Horizontal trimming of small post type insulators, long rod insulators and lightning arresters, NGK



Figures 23 & 24: Vertical lathes for large porcelain pieces, NGK

B. Drying

There are two stages of drying. The first is a semi-drying process to prepare the cylinders for turning. The second is a final drying which brings moisture content in the piece to one percent in preparation for firing. Both drying operations are done by passing an electric current through the cylinder. NGK claims that the control they achieve using this drying process is excellent and their loss experience is said to be low. Further, drying by electric current reduces the time required to dry, especially large pieces, from 2 to 3 weeks to 2 to 3 days.

C. Firing

Firing of post type and large porcelains is done in muffle kilns. NGK periodic kilns are as tall as 20 feet (Figure 26). All NGK kilns are oil fired. In the tunnel kilns, crown stoppers are placed on top the kiln cars to regulate the flow of atmosphere (Figure 25).

D. Testing

Apparatus and bushing shells, and solid core post insulators are subjected to thermal shock tests and ultrasonic tests as well as mechanical impact tests. The electrical and mechanical stress tests are done at 100 percent of rated capacity.

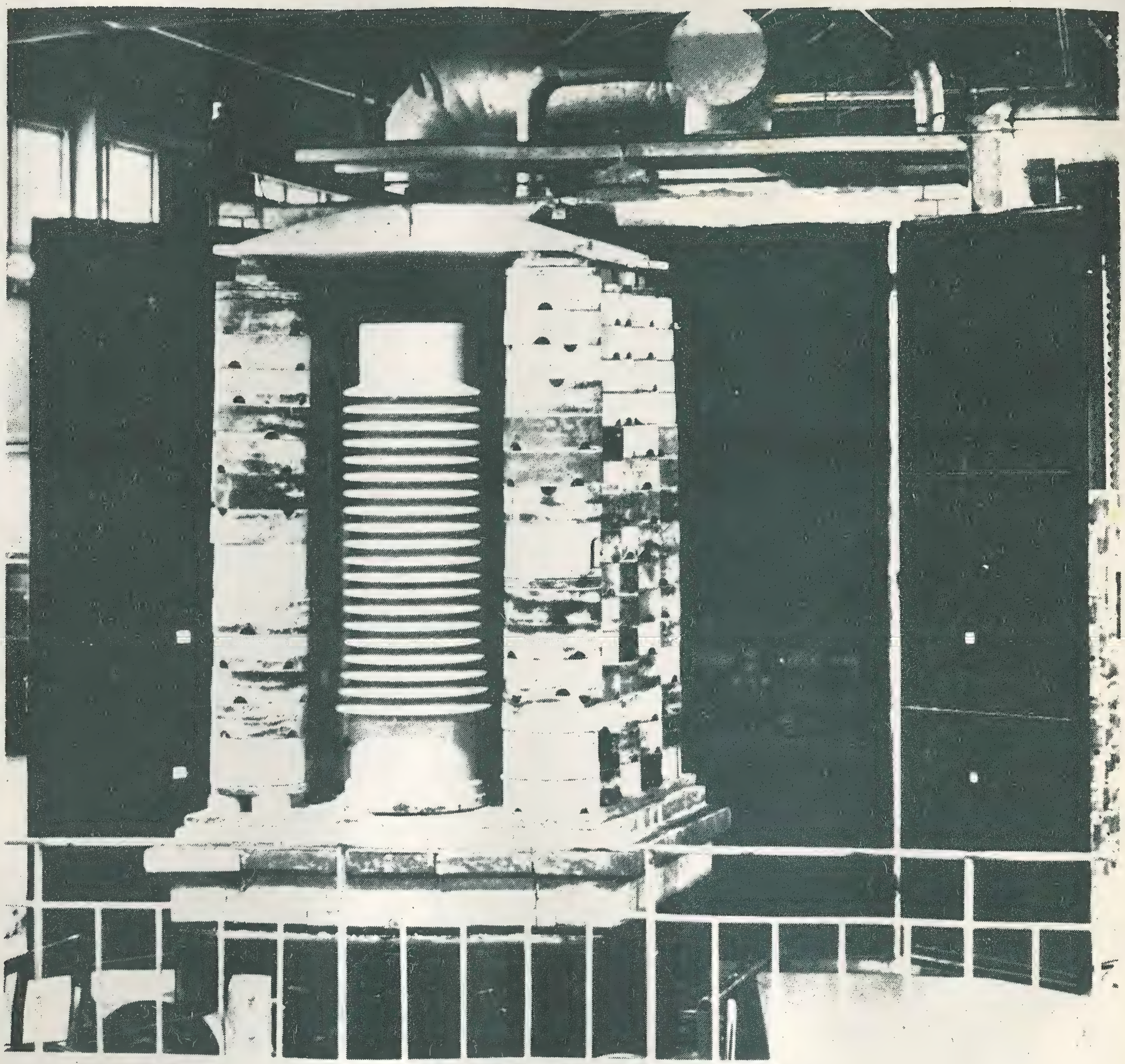


Figure 25: Tunnel kiln for firing large porcelains

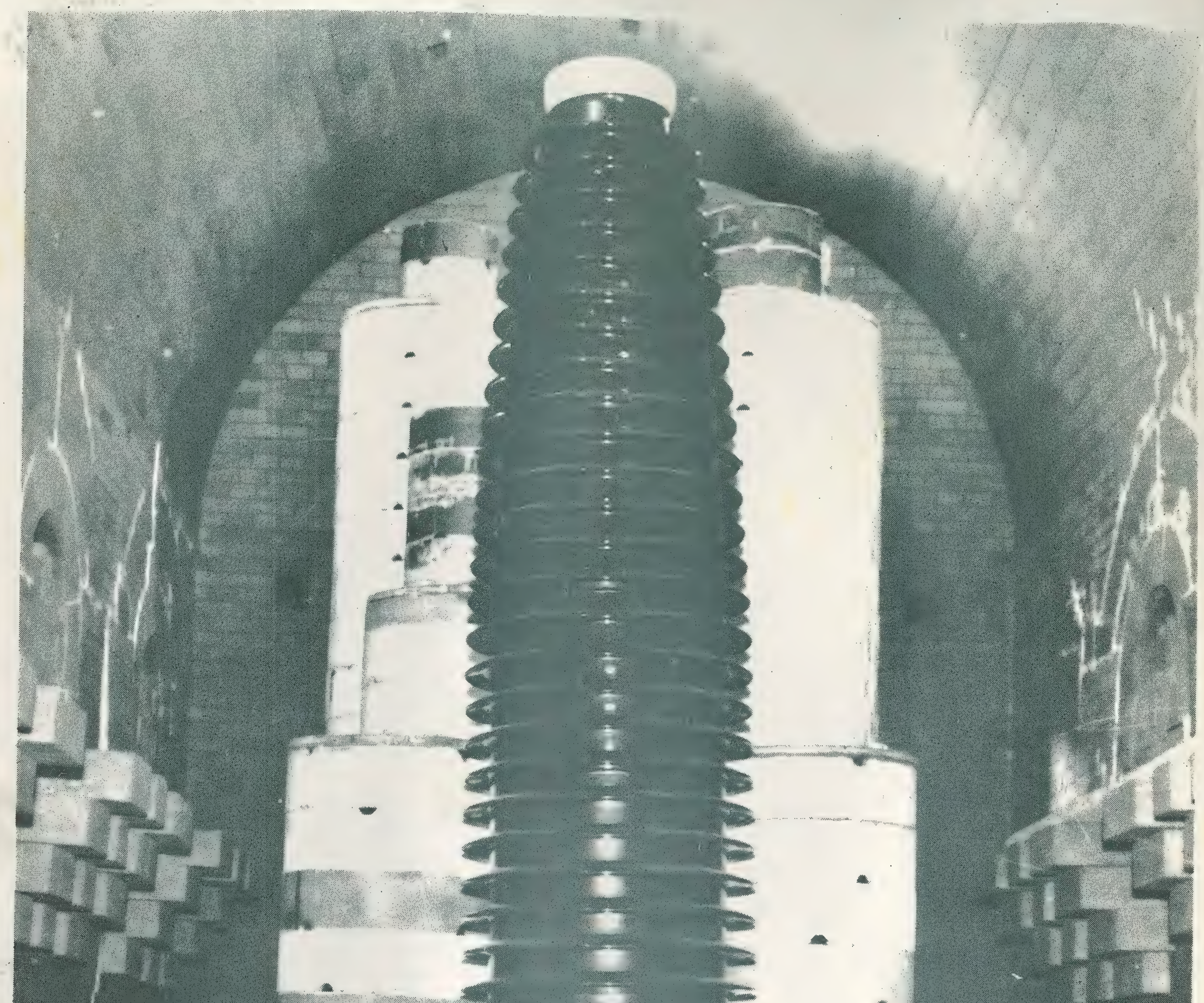


Figure 26: Muffle kiln for firing large porcelains

Resin Insulators

NGK currently produces resin insulators, switches and bushings for indoor applications. They are also experimenting with epoxy resins for suspension insulators but have encountered difficulties. The main drawback to using plastic insulators outdoors is their inability to withstand contamination.

The production processes were described as "primitive" by the section head in charge of plastics at Komaki. The operations included much hand labor in handling and finishing the pieces. Switches, solid core station posts and other small insulators are made by vacuum injection molding. Large station posts, often with hollow cores, and bushing shells are made by laminating the epoxy resins onto a fiber glass core.

Using the vacuum injection mold process, NGK can produce insulators 72 inches tall with outside diameters of 40 inches. The laminating mould equipment can produce insulators 320 inches long with outside diameters of 24 inches.

The basic plastic used by NGK is a bisphenol epoxy resin which is produced from a reaction of bisphenol A and epichlorhydrin with existence of alkali. For outside applications, NGK is trying to develop insulators containing a cycloaliphatic resin that resists ultra-violet rays and other types of contamination.

Production in 1967 was valued at about $56,000 per month, double the monthly rate in 1966. Most of the growth came from sales to electric appliance manufacturers. This report was contained in the Japanese press:

Resin insulators have high growth possibility in the future. Compared to porcelain insulators, the quantity sold is small, but the characteristics of light weight and easy molding have caught the attention of electrical makers who have started using them on special areas of electrical appliances.

Expecting an increase in demand for resin insulators from domestic manufacturers of electrical appliances, the company plans to strengthen the special resin insulator factory in Komaki (monthly production capacity, ¥20,000,000) and to prepare for monthly production of ¥24,000,000 within this year.

Research on plastic insulators is being conducted by companies other than NGK. The two most active are Showa Denko, a large petrochemical and plastics producer, and Hitachi, a major Japanese electrical equipment manufacturer. According to a spokesman at Showa Denko, the chief advantages of resin insulators are the low capital costs necessary to begin manufacturing, the elimination of certain assembly operations, and the light weight of resin insulators. The chief disadvantages are the high cost of the plastics and their inability to withstand weathering. The Showa Denko people do not expect resin suspension insulator development to reach commercially acceptable standards in the next five years.

Research Facilities

Mr. K. Fukuta, executive managing director, stressed the role of research at NGK. He said the work on resin insulators was just one small area of concentration. According to Mr. Fukuta, research expenditures accounted for 4.2 percent of 1966 sales. The payout rate on this investment is high. Of NGK total 1966 sales, about one-third were of products developed between five to ten years earlier. This includes, of course, changes incorporated into insulators.

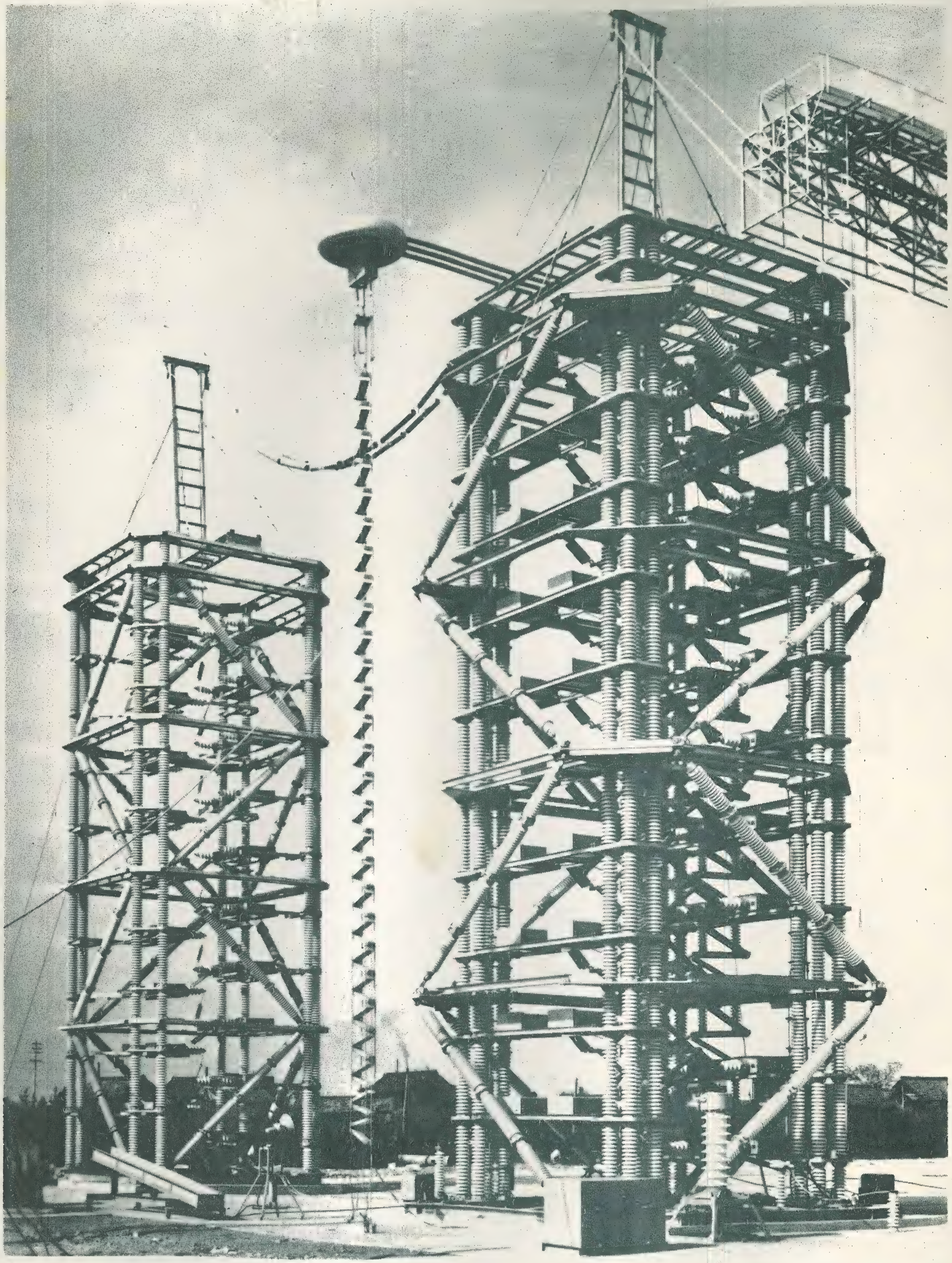


Figure 27: 4,200 kv impulse generator, high voltage testing laboratory, Komaki factory, NGK

Figure 28: Wet flashover test, high voltage laboratory, Komaki factory, NGK

The most important research development for NGK insulators is the construction of a new extra high voltage laboratory at Komaki. The laboratory already has a 3.0 million volt short circuit generator built on tracks so it can be used both indoors and out. A 4.2 million volt impulse generator has been built outdoors together with the first of three adjustable towers. Each tower will be able to sustain a 1,000 KV line. NGK's plan is to string a line across the three towers to simulate actual conditions. At the laboratory, special attention is being paid to the problem of salt water contamination; one test room contains equipment for creating fog and rain.

In summary, the equipment and operations of NGK's Komaki plant are highly mechanized. Although there are some inefficiencies, management is moving to eliminate these as quickly as possible, and they will not hesitate to use capital instead of labor to achieve their goals. As a result, the comparative advantage due NGK from low labor costs is declining. Another reason for this decline is presented in the next section, on labor costs.

LABOR

The stress on mechanization and better efficiency has resulted in higher factory worker productivity. Between September, 1962 and March, 1967, NGK sales increased by almost 100 percent. Yet, the number of NGK factory workers grew by only 11.3 percent, from 3,178 in September, 1962, to 3,483 in March, 1967. In contrast, the number of office workers rose by 63.5 percent,

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Horace J. DePodwin Associates Inc.
350 Fifth Avenue, New York, N.Y. 10001

RECEIVED
JAN 27 1969
E. S. WHEELER

January 24, 1969

High Voltage Insulator Section
Power Equipment Division
National Electric Manufacturers
Association

Gentlemen:

Our report, High Voltage Insulators, Import Competition, contained information about the construction of a new high voltage testing laboratory. We have recently received information that this facility, built adjacent to NGK's most modern factory, at Komaki has been completed.

Enclosed is an article translated from a Japanese trade publication. It details some of the equipment installed in the laboratory and also mentions a few of the research programs to be carried out.

Sincerely,

Achilles Perry

Achilles Perry

/w

Nippon Gaishi Laboratory Completed

Nippon Gaishi Co. invested approximately ¥ 700,000,000 for the construction of the Komaki Extra High Voltage Test Laboratory to prepare for the super high voltage transmission age. The laboratory, which was recently completed, is adjacent to the Komaki Factory. It is designed to allow research and testing insulator for extra high voltage transmission systems ranging from 500 KV to 1,000 KV. It is the largest laboratory of its kind in Asia. Research on 500 KV insulator apparatus will be conducted by a recently formed research team that includes personnel from an NGK subsidiary, Asahi Malleable Iron Co. (Kikukawa-cho, Sizuoka-ken; capital, ¥ 560,000,000; president, Kojiro Nakajima), a manufacturer of line hardware. Programs planned include development of reinforced insulators, more efficient apparatus and machineries, and assembly parts, and improvement of reliability, etc., to prepare for full scale super high voltage transmission which is expected to materialize in the near future.

There is an international trend to super high voltage and high capacity transmission. In the United States and Europe, the super high transmission (over 500 KV) has taken lead; in Japan, electrical power companies are installing 500 KV transmission lines for main lines.

The laboratory has top facilities; some of the features are as follows:

1. The indoor laboratory has an extra high voltage chamber, steel frame reinforced concrete, sized 40 m x 40 m x 30 m (height), with double electromagnetic shielding, and a device to filter external frequencies 75 DB down. The chamber can be darkened completely.

2. The highest A.C. generating voltage is 1,650 KV, and no corona is discharged up to 1,000 KV.

3. An impulse voltage generator of 4,200 KV which generates a switching transient voltage of 2,500 KV for 50 to 500 microseconds in duration.

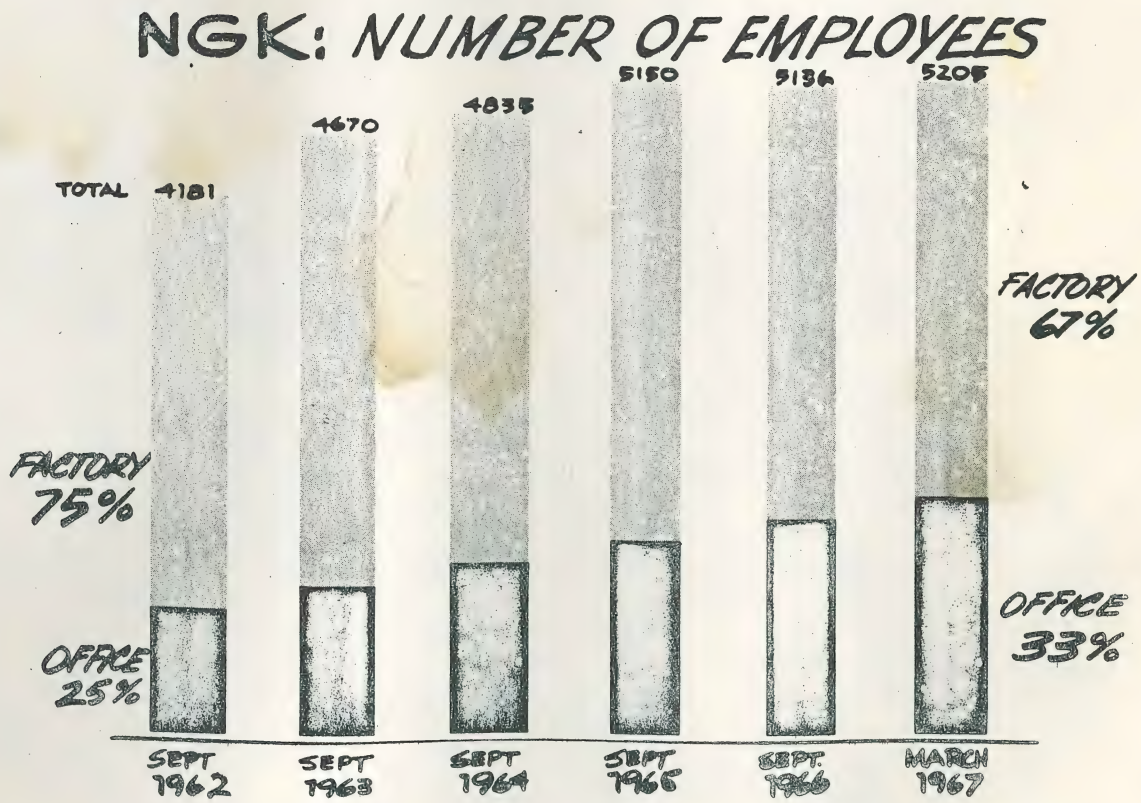
4. In addition to the generator voltage of 500 KV, the laboratory has a basic research facility of 200 KV and a D.C. staining test facility of 200 KV to prepare for D.C. transmission which will be developed in the future.

5. The outdoor facility includes hot-line wet flash-over test equipment, and a wind tunnel which generates wind velocity of 20 m per second, which facilitates comprehensive insulator hot line cleansing test.

6. The various types of iron tower in the outdoor test area enable various electrical and mechanical tests under actual environmental conditions.

from 1,053 in 1962 to 1,722 in 1967. As a result, the ratio of factory workers to office workers declined from 3:1 to 2:1. NGK management people called attention to this fact and stated that increased efficiency in the selling and administrative functions was more difficult to achieve.

The differential between U. S. and NGK wages is significant, but not by as wide a margin as might be thought. The average monthly salary including overtime for all NGK factory workers in March, 1967, was \$114.70. To this must be added 65 percent for bonuses and fringe benefits, giving a total factory employee labor cost of \$189.25 per month.



Average cash earnings including overtime for U. S. workers in stone, clay and glass products industries in December, 1966, were about \$513.81[1] per month. Fringe benefits averaged 16.1 percent[1] of cash earnings net of overtime. Total labor costs per employee were \$593.51. Thus, on a cash earnings basis American employees earned almost four and one-half times what their counterparts in Japan earned. The higher benefits in Japan reduced this margin, however, to a ratio of three to one in favor of United States factory workers.

NGK OFFICE AND FACTORY WORKERS

(at March 31, 1967)

	Office	Factory
Number of Employees	1,722	3,483
Average Age	27.1 years	28.4 years
Average Monthly Salary*	\$130.53	\$114.70

*Net of bonuses
and fringe benefits

The differential between Japanese and American office workers' salaries is much smaller. Japanese office workers earn more than Japanese factory workers;

[1] U.S. Department of Labor. Bureau of Labor Statistics, Handbook of Labor Statistics 1967, pp. 151 and 197.

the situation in the U. S. is just the reverse. The average NGK office worker receives a monthly salary of $130.53. With benefits the total becomes $215.37. Earnings of ten different office clerical occupations in manufacturing in the U. S. ranged from $322.50 for Class B file clerks to $535.35 for Class A accounting clerks. An average of the ten categories, which also include industrial nurses, keypunch operators and secretaries, yields monthly earnings of $411.51. Overtime and fringe benefits raise the total to $493.35, or over twice the labor cost of Japanese office workers. US Salaried

One reason the differential between United States and Japanese office workers is lower than the differential for factory workers may stem from differences in the types of employees included in the categories. But this factor does not appear to be too significant. An analysis of earnings of female employees showed female workers earned about 10 percent more than female factory workers. Since the upward mobility of women in Japanese industry is sharply curtailed, the level of job responsibility is probably the same for the two groups. The difference between office and factory workers' earnings must be explained on a different basis — in terms of traditional Japanese labor and wage policy. Given the difference, however, it can be stated that as the proportion of office workers to total workers employed by NGK rises, NGK's current comparative labor advantage will fall. Another factor contributing to the further decline of NGK's labor advantage is the faster rate of increase in employee earnings in Japan. Between 1962 and 1966, American factory ??? Correct? (see next page)

[illegible]

	US	NGK	Diff
1966	593.51	189.25	404.26
	21%	40%	14%
1962	490.00	135.00	355.00

Raw differential increased even though the NGK "rate of earnings increase" was double US.

W.M. [illegible]
4-1-69

workers' earnings rose 21 percent. The increase in office clericals' was much smaller, 11 percent. Both rates were much lower than the hikes in earnings of 40 percent for NGK factory workers and 62 percent for NGK office workers.

Labor policies in Japan have traditionally called for recruiting and training young workers, especially those who have just left school. These employees then work for the company until retirement. Because of the tendency of lifetime employment, seniority is an important determinant of salary. For the same reason, age, marital status, and amount of education have also been weighed more heavily than job content or employee skill. Lifetime employment policies also serve to explain the high level of fringe benefits. The benefits include such items as housing, meals and recreational facilities. This quote from an NGK brochure is illustrative.

> Company has been putting great emphasis on the importance of human relations and has established the following facilities for the use of employees and their families. Company is giving financial aids for various recreational activities of employees.
>
> Housing for employees with families, Bachelors' Dormitories, Clubs, Dining Rooms, Baths, Playgrounds, Libraries, Medical Clinics, Sanitariums, Financial assistance for recreation such as gymnastic as well as cultural club activities.

Some of the fringe benefits not always available to U. S. workers have been made mandatory by statute in Japan. For example, Japan has a comprehensive system of public health insurance which pays hospital and medical expenses plus up to 26 weeks of benefits at up to 60 percent of wages.

The most significant difference between U. S. and Japan wage policies is the system of semiannual bonuses paid to Japanese workers. At NGK these bonuses equal more than four months salary. This is not unusual for Japanese industry. The bonuses are paid on a profit sharing basis, in proportion to each employee's salary.

The lifetime employment concept is beginning to be questioned by Japanese industry. NGK management was particularly forceful in stating their preference for hiring young girls. According to the Komaki plant manager, these girls work about five years before they marry. This keeps labor costs down by avoiding pay increases for seniority only and limits the demand for welfare payment such as housing. Young girls are in short supply, largely because other companies feel as NGK does. As a result, another traditional Japanese wage policy — discrimination by sex — is slowly changing. As the supply continues to fall, the average wage of women will rise.

The long term outlook for NGK labor costs is sharply upward because of these three factors:

- Rapidly rising wage rates;
- Decrease in proportion of factory workers to office workers;
- Elimination of wage differentials because of sex, age, or marital status.

But, for now, a significant differential in labor costs exists. It is necessary to translate this advantage into its effect on price to determine by what margin NGK can undercut United States market prices without having to subsidize sales in the U. S. by discriminatory prices.

The second major ingredient in the cost of insulators is raw materials.

NGK 25000 lb
Insulator Duplication

De Podwin Report
For CA525MR (Non Alumina Body)

SHELL Raw Material WT = 7.7 lbs (No Alumina – Old Design)
Fired SHELL WT = 7.0 lbs (")
SHELL COST 7.7 lbs × .0138 \$/lb Body Cost Raw Material Only. @ unit
Cap & Pin WT (Total) = 3.67 lbs = Est Cost \$.64–.66 @ unit
Est Cost of Porcelain Shell \$.53 ea
Assembly Cost Est \$.11 @
Total Cost To Produce UNIT \$1.28 @
Selling Cost \$.26 @
Total Cost \$1.54 @
Assembly WT 10.67 lbs
Cement Silica filled.

NGK 500 MQ
– Alumina Body –

Shell WT	7.9 lbs BY DIF
Cap WT	3.4 lbs
Pin WT	.7 lbs
Assembly WT	12.4 lbs.
Cement WT.	Est .4 lbs

Cement Speed – linear expansion coefficient of less than .03 %
Steam Cure 2–3 days.

/ / / / / / / / / / / / / / / / / /

GE Design Duplication for NGK Cat No DA500MQ
Alumina Body – Redesigned NGK UNIT Ball & Socket

Shell WT. = 8.5 lbs = 304 Body Cost/lb = ______ \$. @
Cap WT = 3.4 lbs
Pin WT = .7 lbs
Assembly WT =
Cement WT = .4 lbs Est.

Quote PMI \$.68 @
Quote \$ @

13.0

RAW MATERIALS

The basic material for NGK insulators is pottery stone, usually classed as Lyparite, a natural blend of quartz, sericite and other materials including kaolinite. This product is mined in Japan and supplied to NGK through a mining company that is affiliated with the Noritake complex. Four samples of NGK raw materials were subjected to chemical analysis. Two of the samples were of the finest grade pottery stone from the Amakusa region. The other two samples were of prevalent Japanese clays used by NGK. The composition of these materials is presented below:

				Amakusa Pottery Stone	
Chemical Analysis		Gairome Clay	Kibushi Clay	Hisatsune Mine	Ueda Mine
Silicon dioxide	SiO_2	50.3%	49.8%	76.8%	78.5%
Aluminum oxide	Al_2O_3	33.7	31.2	16.5%	15.0
Iron Oxide	Fe_2O_3	1.4	1.3	0.2	0.3
Titanium dioxide	TiO_2	0.7	0.8	0.2	0.1
Calcium oxide	CaO	0.4	0.0	0.3	0.2
Magnesium oxide	MgO	0.5	0.7	0.1	0.3
Sodium oxide	K_2O	1.4	1.1	0.3	2.4
Potassium oxide	Na_2O	0.2	0.1	0.1	0.1
Loss on Ignition		12.0	14.2	5.6	3.2

Mineral Names				
Clay (kaolinite)	77%	72%	23%	10%
Pyrophyllite	0	0	23	15
Sericite	10	10	3	18
Quartz	10	12	47	55
Other	3	6	4	2

According to data from NGK and from independent clay companies, Japanese prices for raw materials have risen sharply in the last five years. Prices for pottery stone, the principal raw material, had risen to $20.46 per metric ton as of March, 1967 — 21 percent higher than in 1962. These prices do not include transportation charges and are for materials in bulk form. According to clay company spokesmen, Japan's supply of special grade Amakusa pottery stone, the type used by NGK, is beginning to diminish critically, and its price will continue to rise.

The most expensive raw material used in NGK insulator bodies is Gairome clay — a type of ball clay. Prices for this clay rose from $23.89 per metric ton to $30.28 per metric ton, an increase of 27 percent between 1962 and 1967.

NGK RAW MATERIAL PURCHASES

	Consumption 6 Months Ending March 1967	Price* March 1967	Price* March 1962
Amakusa Pottery Stone (and Feldspar)	18,843 tons	$20.46/ton	$16.90/ton
Gairome Clay	9,282 tons	30.28/ton	23.89/ton
Kibushi Clay	1,699 tons	17.86/ton	11.80/ton
Pig Iron	1,120 tons	n.a.	n.a.
Steel	4,380 tons	119.45/ton	116.68/ton
Light Fuel Oil	12,685 kl	30.56 kl	36.95 kl

Ton = metric ton (2,204 lbs)
kl = kiloliter (264.2 U. S. gallons)

*Bulk form, net of transportation.

Prices paid by U. S. manufacturers for their raw materials usually include charges for crushing and transportation. Since NGK buys its materials in bulk form and the purchase price does not include transportation, it was necessary to adjust the price of Amakusa pottery stone for crushing. According to the experience of both U. S. ceramics manufacturers and the International Mineral & Chemical Corporation (Skokie, Illinois), grinding can double the price of feldspar, net of freight.

Crushing must be relatively more expensive for NGK since it has great excess capacity in crushers. At Komaki, the "Impeller breakers" are used less than one full shift per day. The assumption used in calculating NGK's body cost, however, was conservative, i.e., that crushing costs the Japanese less than American manufacturers and that it increases the price of Amakusa pottery stone by 33 percent.

NGK PORCELAIN BODY
Cost per Pound of Blended Raw Materials

	Adjusted* Raw Materials Prices	Weights: Consumption for 6 mos. ended March 1967
Amakusa Pottery Stone (and feldspar), ground	$29.92	18,843 metric ton
Gairome Clay	33.31	9,282
Kibushi Clay	19.65	1,699
Weighted average body cost	30.390/metric ton .0138/pound	

* Adjustments include a 33 percent increase in price of Amakusa pottery stone for crushing plus 10 percent increases in the price of each raw material for transportation costs.

The only commodity to decline in price was oil, which declined from $36.95 per kiloliter to $30.56 per kiloliter, a drop of 17 percent. The ceramic industry in Japan uses a light grade A fuel oil (equivalent to Number 2 fuel oil) with sulphur content of about .05 percent by weight. According to spokesmen at Shell in Tokyo, there has been some movement towards using heavy oil in firing ceramics. If NGK is able to adopt a heavier oil for their firing, their fuel costs will drop by about a third. Grade B fuel oil, the next heaviest, now costs ¥ 8000 to ¥ 8700 per kiloliter. The heaviest oils, Grade C, cost ¥ 7000 to ¥ 7500 per kiloliter.

Freight costs in the United States are much higher than in Japan, largely because of the nearness of raw material deposits in Japan. In the United States it is not unusual for transportation costs to equal the price of the crushed raw material. For the purposes of computing NGK's body costs, however, it was assumed that transportation charges increased the price of raw materials by 10 percent.

The weighted body cost was calculated using the adjusted raw materials prices weighted by the amount of each consumed. It was found to equal $30.390 per metric ton, or $.0138 per pound. This is comparable to U. S. manufacturers' body costs. It is, therefore, doubtful that Japan has any comparative advantage over U. S. producers based on raw material prices.

COSTS AND MARGINS

The high relative costs of raw materials including fuel are confirmed by examining the distribution of NGK production costs. For the six months ending March 1967, raw materials represented over half, 54.1 percent of total NGK production costs. Despite the rise in raw material prices between 1962 and 1967, their share of production costs declined slightly from the March, 1962 level of 56.2 percent. The reason for their decline in share was the even more rapid rise of NGK labor costs. As stated earlier, employee monthly earnings rose by more than half between 1962 and 1967, outpacing NGK's increases in productivity. As a result, labor's share increased from 28.9 percent to 34.4 percent of total production costs. The rise in benefits was faster than the rise in wages.

DISTRIBUTION OF NGK PRODUCTION COSTS

		6 Months Ending March, 1967		6 Months Ending March, 1962	
Raw Materials (including fuel)	(2.1)		54.1%		56.2%
Labor	5.5		34.4		28.9
Salary		20.9%		18.7%	
Benefits		13.5		10.2	
Other Expenses	(2.8)		15.4		18.2
Depreciation		5.3		7.8	
Adjustments			(3.9)		(3.3)
Total Production Costs			100.0%		100.0%

Total Costs

Production costs represented 70.0 percent of NGK's 1966 sales. Selling and administration expenses were 13.9 percent, slightly lower than U. S. producers' costs. The level of these expenditures correlates more closely with production costs than with net sales. This means that most of this category of expense represents fixed costs at given volume of sales. This would be expected where, as in the case of NGK, there is little marketing or advertising outside of personal contacts with the customers.

After deducting production, selling, and administrative costs, NGK's gross margin on net sales was 16.1 percent. This was somewhat higher than the gross margins in 1965 and 1964 but still below 1962-63 levels. Net after tax rose in direct proportion to the rise in gross margin from 4.2 percent in 1965 (NGK's lowest net in the past five years) to 6.4 percent. (See table below.)

NGK PROFIT AND LOSS STATEMENT

	Year Ending March, 1967	
Net Sales	$55,902,000	100.0%
Cost of Goods	39,112,000	70.0
Sales and Administration	7,783,000	13.9
Operating Profit	9,007,000	16.1
Other Expenses	3,362,000	6.0
Taxes	2,084,000	3.7
Income after Taxes	3,561,000	6.4

FINANCIAL ANALYSIS

NGK's financial statements reflect the legal-economic framework and management philosophy that affect the financial structure and operations of Japanese corporations. Japan does not, for example, have a well developed bond market. Also Japan's rediscount rate is very high; at year-end 1967 it was 5.9 percent compared to 4.5 percent rate in the United States. The inaccessibility and high cost of non-equity outside financing combine to minimize NGK's use of long-term debt.

In 1963, for example, NGK retired $7.0 million of its long-term debt. This reduction was effected primarily through a $4 million increase in equity capital. The remainder was funded partially by an increase in short-term debt and and partially by a reduction in the NGK cash balance. The decision not to renew the long-term commitments meant that NGK considered equity capital to cost less than non-equity capital, even with a dilution in the rate of return to equity from 12.9 percent to 10.0 percent. The latest additions, in 1967, to NGK plant capacity were also financed through internal funds, again to avoid long-term debt. These funds were probably generated as follows: 60 percent from NGK 1967 net income, 25 percent from depreciation flows, and the remaining 15 percent from a special fixed asset write-off.

Despite the high costs of capital in Japan, NGK seeks to expand rapidly for two reasons. First, the Japanese government is committed to a policy of rapid economic growth — especially in the export sector. To promote export

growth, Japanese tax laws provide special depreciation allowances for expansion of plant and equipment to be used in manufacturing exports. As a result, NGK's tax burden is lower than that of most U. S. companies. In 1966, for example, NGK's corporate taxes were 35.5 percent of pre-tax income compared with an average 41.2 percent tax load for all U. S. corporations. The second reason for NGK's expansion-mindedness is less specific and concrete. It stems from a Japanese management philosophy that sometimes values growth more than profitability. This desire to grow rapidly combined with tax incentives and a stagnant home market have turned NGK's expansion moves to the export market. For example, it was noted earlier that construction of the Komaki plant, which exports over 85 percent of its production, was linked solely to export demand, especially from the United States. As long as insulator demand remains brisk, NGK will not have too much difficulty in maintaining a profitable operation, despite their rapid expansion of capacity. Indeed, the new plant and equipment should help NGK's profitability. One key determinant of profitability, plant efficiency, is measured by the ratio of sales to fixed assets. In the four years between 1963 and 1967, NGK's sales-to-fixed-asset ratio increased sharply from 1.6:1 to 3.6:1. While NGK's accelerated depreciation rates make this measure of increased efficiency higher than it actually is, the direction and magnitude of the change is still significant (see table below).

The rapidity of NGK expansion combined with certain of NGK's financial policies, however, could create serious difficulties for the company in the event of a sharp turn-down in demand. NGK, for example, operates very close to INSOLVENCY

NGK BALANCE SHEET AND SELECTED FINANCIAL RATIOS

(Thousands of Dollars)

	March 31 1963		March 31 1967	
BALANCE SHEET (6 mos. ended)				
Current Assets				
Cash	$7,516,382		$11,674,304	
All Inventories	9,195,454		12,241,686	
Accounts Rec. (Net)	362,733		465,159	
Other Current Assets	9,516,862		9,798,967	
Total Current Assets		$26,591,432		$34,180,117
Non-Current Assets				
Deferred Payments			107,926	
Investments	4,996,584		8,430,700	
Total Non-Current Assets		4,996,584		8,538,626
Fixed Assets		17,931,540		15,432,726
Intangibles		179,918		174,421
Total Assets		$49,699,475		$58,325,892
Current Liabilities		$18,902,165		$30,842,177
Long-Term Liabilities		16,542,838		6,768,807
Special Reserve				1,254,571
Total Liabilities		35,445,003		38,865,555
Total Equity		14,254,472		19,460,336
Total Liabilities and Capital		$49,699,475		$58,325,892

FINANCIAL RATIOS (year ended)

	1963	1967
Current Ratio	1.4 : 1	1.1 : 1
Inventory Turnover	3.1 : 1	4.6 : 1
Sales to Fixed Assets	1.6 : 1	3.6 : 1
Return on Equity	12.9%	18.3%

insolvency. Its current ratio, the ratio of current assets to current liabilities, has fallen to 1.1:1, well below the 2:1 level considered healthy for most U. S. corporations. Working capital, the surplus of current assets minus current liabilities, another measure of corporate liquidity, has also fallen. On March 31, 1963, NGK's working capital was $7.7 million on a base of $26.6 million in current assets. By March 31, 1967, working capital had fallen to $3.3 million despite a rise in current assets to $34.1 million.

NGK is able to operate near insolvency because they maintain high cash balances that provide the liquidity necessary during periods of brisk sales growth. The high cash balances, in turn, are the result of NGK's policy of "cash" sales. This policy is reflected in the small accounts receivable — less than two percent of sales — in contrast to a cash balance of over twenty percent of sales. Another aid to operating near insolvency is a low inventory. A low inventory provides extra liquidity by reducing the length of time assets are held inactively. This measure of liquidity is the sales-to-inventory ratio. NGK's ratio has always been fairly high but in the last four years it has gotten higher. From March, 1963 to March, 1967, NGK's sales-to-inventory ratio rose from 3.1:1 to 4.6:1. 1967 1968 10:1 11:1
Cash balances and inventory levels are very sensitive to declines in sales, however, and if NGK's production falls below its present full capacity rate, serious financial problems could present themselves.

The most immediate problem would be a liquidity crisis in which current liabilities would exceed current assets. NGK's solutions to such a problem are limited. First, they have no accounts receivable to factor or borrow against.

Second, they have been purposefully avoiding long-term debt and would certainly seek to avoid incurring such debt to alleviate temporarily a liquidity problem. In light of these restrictions, NGK would retain two alternative solutions, an increase in equity capital or lower prices. An increase in equity capital could be expensive and would also cause a dilution in earnings. It might also restrict NGK's ability to return to the capital market in the early future to satisfy other needs that might arise. And, depending on how quickly the liquidity problem arose, NGK might not have enough time to arrange an increase in capital stock. An aggressive price policy, aimed at raising sales to increase cash flows, could provide a solution to an NGK liquidity problem. Lower prices could also help, in the event of a sales decline, to avoid a severe drop in capacity utilization and the consequent rise in per unit costs.

A reduction of home market prices would probably not achieve much for NGK. A price drop could not significantly aid NGK in raising sales by increasing its share of the Japanese market; NGK already has 80 percent of the market. Also, Japanese utilities have not traditionally bought on price and would not anticipate insulator needs to take advantage of low prices. But a price cut in exports could serve to accelerate NGK's penetration of other markets, including the United States. There is already evidence that NGK has used low prices in export markets, not to avoid financial problems but to continue its expansion program in the face of a stagnant home market. For example, NGK is not as profitable as would be expected of a company that has virtually monopoly control of its home market.

Their after tax profits in 1967 were 6.4 percent, slightly lower than the 6.7 percent average net income after taxes for American stone, clay, and glass manufacturers.

NGK's low profitability may reflect aggressive pricing in export markets. If so, then it is also possible that its home market's insensitivity to price has led NGK to a policy of differential prices — prices which are lower in the export market than in the home market.

V. THE DUMPING DIFFERENTIAL

The sections that follow seek to determine whether or not Japanese sales in the United States are at less than fair value. Two basic approaches were used, each based on alternative measures that may be used by the Treasury Department in their determination of dumping. The first method was to construct a fair value price based on NGK raw material and labor costs and the relationship of these costs to total production costs, sales, and profits. The second method of determining fair value prices was to obtain actual Japanese home market prices and to compare them to prices on sales to the U. S.[1]

NGK Per Unit Production Costs

The first step in calculating a constructed fair value price was to calculate the cost of producing and selling an insulator. Based on company as a whole data, supplemented by specific information on Komaki production costs, it was calculated that a 25,000 pound suspension insulator has a factory cost of $1.28 to $1.32. NGK selling costs added to this expense raise the per unit cost to a range of $1.54 - $1.58.

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[1] A third method listed in the Antidumping Code provides for a comparison of prices between sales to the U. S. and export sales by the dumping party to a third country. This alternate method need only be used when no home market exists for the exported product.

How accurate are the calculations? The assumptions underlying the estimates were based, conservatively, on statements by NGK personnel, their company's official cost statement, and from corroborating information obtained from other Japanese sources such as mining companies and the Japanese government. These assumptions and estimates would tend to provide an upward bias.

NGK PRODUCTION COSTS FOR
25,000 POUND SUSPENSION INSULATOR

	Based on Labor Costs	Based on Raw Material Costs
Cost of Porcelain Shell	$ .66	$ .53
Cost of Assembly		.11
Cost of Hardware	.66	.64
Production Cost	$1.32	$1.28
Selling Expense	.26	.26
Cost per Unit	$1.58	$1.54

The analysis was done twice, each time based on completely separate assumptions. The two estimates were almost the same. This lends support to their accuracy. The first method used was based on raw material costs and included the following assumptions:

- A raw material cost of $.0138 per pound. (See section on raw material costs, pages 95-98.)
- The porcelain shell of an NGK 25,000 pound suspension insulator uses 7 pounds of raw materials, plus 10 percent wastage. According to the NGK catalog, an assembled insulator weighs 10.67 pounds. The metal was assumed to weigh 3.67 pounds or 34 percent of the total.
- Raw material costs represent 20 percent of the costs of production for the porcelain component. This assumption and the two that follow are based on a direct statement by the plant manager at Komaki. Mr. Niki defined production cost as including all overhead charges for plant, equipment and testing in addition to direct charges such as labor.
- The cost of assembly equals 20 percent of the cost of porcelain.

- The cost of the hardware equals the cost of the porcelain and assembly.
- Selling and administration expenses equal 20 percent of the production cost, the relation of these costs as presented in NGK's financial statements.

The total cost of the porcelain shell under these assumptions is $.53 ($.0138 X 7.7 pounds ÷ 20.0%) and the total unit cost of the assembled and marketed insulator is $1.54. (See table above.)

The second method of analysis was based on knowledge of the Komaki plant's monthly production and labor. It yielded results similar to the analysis based on raw material costs.

- Monthly production at Komaki was 510,000 pieces per month in 1966 according to the plant manager who also said:
- The plant employs 604 persons for the production of insulators (net of personnel assigned to plastics or the high voltage research laboratory).
- These employees include 80 percent male, 20 percent female; 453 factory workers, and 151 office workers.
- Labor costs represented 34 percent of production costs according to NGK data.
- The distribution of costs between porcelain shell, assembly, hardware, and selling expenses is the same as in the first analysis.

Information presented in the earlier section on NGK labor costs was used to compute a weighted average monthly labor cost of \$119,527. This produced an average labor cost per insulator of \$.226 (\$119,527 ÷ 510,000 pieces per month). Production at Komaki consists of making the porcelain shell and assembling it to hardware components received from other NGK factories or subsidiaries. Consequently, the costs of hardware were considered extra. Thus, the cost of the porcelain shell plus assembly was calculated at \$.665 (\$.226 ÷ 34%, the proportion of labor costs to total production costs). The total unit cost of the insulator was calculated at \$1.58.

CONCLUSIONS ON PRODUCTION COST METHOD

NGK operating profits were 16.1 percent for the year ended March, 1967. If NGK was pricing fairly, the gross margin in the export market would equal or exceed the gross margin in the home market. Thus, the constructed fair value price of these insulators to U. S. customers is \$1.88, FOB Nagoya (assuming no differential for packaging costs).

The actual FOB Nagoya price of an NGK 25,000 pound suspension insulator (Catalog No. CA-525MR) sold to TVA in 1966 was \$1.64, or 14.6 percent lower than the constructed fair value price. On the basis of the constructed fair value price, NGK is dumping in the U. S. by a margin of at least 14.6 percent.

The actual differential is probably greater than 14.6 percent. The gross margin between the lowest estimate of unit cost, \$1.54, and the FOB Nagoya price to the U. S., \$1.64, is only 6.4 percent. Thus, NGK sales of insulators in Japan must be raised enough to subsidize the export sales and still produce an operating profit of 16.1 percent.[1]

The actual differential between home and export prices can be determined by solving an equation based on the distribution of NGK's dollar value of sales, by type of product. The factors in the equation are listed below.

\$4,200,000 = sales of chemical machinery and special metals and ceramics in both home and export markets.

\$12,945,000 = export sales of insulators.

\$11,944,000 = home market sales of insulators.

\$29,089,000 = total company sales.

0.161 = gross margin on total company sales.

0.064 = estimated gross margin on export sales of insulators.

X = gross margin on home market sales of insulators.

Σ [sales of product A (gross margin, product A) + sales of product B (gross margin, product B) + ... sales n (gross margin, n)] = company sales, all products (gross margin, all products).

$$\$4{,}200{,}000\,(0.161) + \$12{,}945{,}000\,(0.064) + \$11{,}944{,}000\,(X) = \$29{,}089{,}00\,(0.161)$$

$$X = 0.266$$

---

[1] Since insulators accounted for 84 percent of NGK's dollar sales, it is unlikely that the difference in gross margins could be made up by sales of chemical machinery or other NGK specialty products. In the equation below, the gross margin on such sales is assumed to be equal to the gross margin on total company sales.

Thus, in order to produce a 16.1 percent gross margin on total company sales, it is necessary for home market sales to be made at prices including a gross margin of 26.6 percent.

Based on the lower unit cost estimate, $1.54, a 25,000 pound suspension insulator sold in Japan would be priced at $2.10. This price was obtained from the following proportion where X equals the home market price:

$$\frac{\$1.54 \text{ (production cost)}}{\text{X (home market price)}} = \frac{(\$1.00 \text{ (price)} - 0.266 \text{ (gross margin)}}{1.00 \text{ (price)}}$$

$$\text{X} = \$2.10 = \text{home market price}$$

Since the FOB Nagoya price to the United States is $1.64, the differential between Japanese home market and export market prices is estimated at 28.0 percent.

JAPANESE HOME MARKET PRICES

The existence of discriminatory pricing was confirmed by a second method of analysis — based on Japanese sales of insulators in their home market. According to the Anti-Dumping Law and the Bureau of Customs regulations which implement it:

> Merchandise imported into the United States will ordinarily be considered to have been sold...at less than fair value if the purchase price...is, or is likely to be, less than the price at which such or similar merchandise is sold for consumption in the country of exportation...

The lowest price reported in Japan for home market sales of 25,000 pound suspension insulators was ¥ 780 or $2.17. This price was obtained from Mr. K. Fujita, President of Osaka Togyo Kaishi (OTK). It is 3.3 percent higher than the home market price calculated on the basis of NGK production costs and 32.3 percent above the FOB Nagoya price to the U. S.

A second source of home market prices was the wholesale price index prepared by the Bank of Japan. This index reported a price of ¥ 810 ($2.25) for all ten-inch suspension insulators. This price was most commonly stated by insulator purchasers such as Tokyo Electric Power.

Prices for several kinds of insulators were also obtained from the Economic Research Institute. This is a quasi-public organization under the jurisdiction of Japan's Economic Planning Agency. The price information collected by the Institute's 248 employees is highly regarded in Japan and is used, for example, by the Comptroller's Office of the Government of Japan in evaluating performance on government contracts. Among the series collected for high voltage insulators is one covering 25,000 pound clevis type suspension insulators. The prices and specifications for these insulators, contained in Japanese Industrial Standard C-3810, are summarized in the table below. The lowest price reported in the six city survey was for Hiroshima, ¥ 805, or $2.24, in line with the prices reported by the other sources.

These are not individual transaction prices. The Economic Research Institute data, for example, are an average of cash prices, net of discounts, to five large wholesalers in each city. Less than 10 percent of Japanese insulator sales go through wholesalers. Most sales are made directly to customers like Tokyo Electric Power. Consequently, it is possible that the bulk of sales are made at prices below those to wholesalers.

JAPAN HOME MARKET PRICES

25,000 Pound Clevis Type Suspension Insulators

	Mar. 1964	Oct. 1964	Mar. 1965	Oct. 1965	Mar. 1966	Oct. 1966	Mar. 1967
Tokyo	$2.64	$2.36	$2.50	$2.36	$2.36	$2.36	$2.36
Osaka	2.22	2.22	2.22	2.22	2.36	2.39	2.39
Nagoya	-	2.39	2.39	2.39	2.39	2.39	2.39
Fiukuaka	-	-	2.19	2.25	2.25	2.25	2.25
Hiroshima	-	2.24	2.24	2.24	2.24	2.24	2.24
Sendor	-	-	-	-	2.36	2.36	2.36
Sapporo	-	-	-	-	2.38	2.38	2.38

JAPANESE INDUSTRIAL STANDARD NO. C3810-1966

Capacity of Clevis Type Suspension Insulators

Voltage Breakdown Load	12,000 kg (26,455 lbs)
Tensile Resistance Load	4,000 kg (8,818 lbs)
Dry Flashover	80 KV
Wet Flashover	50 KV
50% Impulse Flashover	125 KV
Commercial Frequency	140 KV

Source: Economic Research Institute, Sekisan Shiryo, Monthly, Tokyo, Japan.

Two widespread sales conditions in Japan that affect prices are quantity discounts and credit allowances. Quantity purchases for products similar to insulators usually are granted 10 percent discounts. Also, wholesalers are often given as much as 180 days credit. Assuming a Japanese interest rate of 8 percent per year, this can equal an additional 4 percent discount. For the sake of conservatism, allowance was made for both reductions to price for the data collected from the Economic Research Institute. Thus, the lowest price (Hiroshima, $2.24) becomes $1.92. This is 8.6 percent below the home market price calculated on the basis of NGK gross margins but still 17.7 percent above the FOB Nagoya price to the U. S. of $1.64. Without the reductions the $2.24 price is 36.6 percent above the Japanese price to the United States.

It is apparent that NGK is pricing suspension insulators lower in export sales to the United States than in sales to their home market. The differential ranges from 17.7 to 36.6 percent depending on assumptions made as to what is included in the Economic Research Institute data. The differential calculated by the production cost method was 27.2 percent, almost exactly in the center of that range.

VI. EFFECTS OF DUMPING ON U. S. PRICES

JAPANESE COSTS OF ENTRY TO U. S. MARKETS

In order to assess fully the effects of NGK's differential prices on the U. S. insulator market, it is necessary to translate the FOB Nagoya price into a delivered price. According to TVA contract records, the same insulator (NGK Catalog No. CA-525MR, a 25,000 pound suspension), which is priced $1.64 FOB Nagoya, costs $2.52, or 53.6 percent more, delivered to the TVA construction site. The breakdown of the costs of entry is presented in the table below. Also presented is a hypothetical price to TVA on the assumption that TVA pays the same price as Japanese electric utilities, i.e., the home market price which prevails in Japan. The home market price selected for this analysis, $2.10, is the price calculated by the production cost method. It also represents a price in the middle of the range of actual Japanese prices summarized above.

NGK SUSPENSION INSULATOR PRICES TO TVA

(NGK Insulator, Catalog No. CA-525MR)

	Actual Price to TVA		If At Japanese Home Market Price	
Price FOB Nagoya		$1.6400		$2.1000
Ocean Freight	$.3176		$.3176	
Marine Insurance	.0066		.0084	
Price c.i.f. New Orleans		1.9642		2.4260
U. S. Import Duty	.2460		.3210	
Customs Bond	.0006		.0010	
Pier Handling	.0116		.0116	
Mitsubishi Commission	.0820		.1050	
Landed Cost to NGK at Port of Entry		2.3044		2.8646
Inland Freight	.1650		.1650	
Surety Bond	.0030		.0030	
Delivered Cost to NGK at TVA Site		2.4724		3.0326
NGK Selling Expense and Profit		.0476		.0609
Unit Price		$2.5200		$3.0935

By calculating the amount of each of the costs of entry, such as U. S. Customs duty, ocean freight and pier handling, it is possible to estimate the effect of a change in the FOB Nagoya price on the price to the U. S. market. Based on the calculations presented in earlier sections, if NGK were required to price fairly in the U. S. — at Japanese home market price levels — their FOB price would rise about 28 percent, from $1.64 to $2.10 for a 25,000 pound suspension insulator (No. CA-525MR). This 28 percent rise in the FOB price would produce about a 23 percent rise in NGK America's delivered prices.

The lesser increase in the delivered price results from the relative decline in ocean freight and other costs of entry that are calculated on the weight or volume of the insulator rather than its FOB value. Thus, ocean freight declines from 19.4 to 15.1 percent of the FOB value when the price is increased from $1.64 to $2.10. The actual freight charge remains the same, $.3176 per insulator.

The second major cost of entry, customs duties, is 15 percent of the FOB values in both cases. Thus, as the Japanese price of insulators rises, duty is of the same importance as a cost of entry. But, the actual duty rises from $.2460 to $.3210 per insulator.

Based on analysis of TVA and Bonneville insulator awards, a 23 percent rise in NGK prices would have been sufficient to switch over half the awards won by NGK to U. S. manufacturers. Of 31 contracts, NGK's bids were 10 to 20 percent lower on ten contracts. U. S. bids would clearly have had a good chance of the award in these cases. In another ten cases, NGK's bids were 20 to 30 percent lower than American bids. A 23 percent increase in NGK's price plus the

minimum six percent price preference Federal power agencies must give U. S. companies would have given American producers a good chance of winning these contracts, too.

NGK need not raise their prices by the full 23 percent. They could elect to redistribute their earnings by simultaneously reducing their home market prices and raising their export prices. In this case, NGK prices to the U. S. would rise by about 11 percent — still enough to make U. S. producers' bids competitive on a good proportion of Federal power agency contracts.

Note on Calculation of NGK Costs of Entry

The FOB Nagoya price and delivered price to TVA were obtained from TVA contract records. Other information contained in these records includes type of insulator, number purchased, import duties, inland freight and surety bond. The other costs of entry were obtained from published tariffs and interviews. In most cases, the data were for more than one insulator and it was necessary to convert them to per unit costs. The insulator characteristics used for these conversions were obtained from the NGK Catalog. A summary of the insulator characteristics and other data and sources used in the analysis of costs of entry is presented below.

Insulator Characteristics

NGK's suspension insulators No. CA-525MR have a combined M & E strength rating of 25,000 pounds and conform to ASA spec. number 52.5 and TVA spec. number 26.015. They are shipped six insulators per wooden crate; each crate weighs 73 pounds and occupies 2.42 cubic feet. The net weight of each insulator is 10.667 pounds.

Ocean freight: Certain TVA records included bills of lading showing that NGK insulators are shipped to TVA via Lykes Bros. Steamship Co. The freight rate shown on these bills of lading is $31.50/40 cubic feet. This rate is in accordance with those published for the Japan-Atlantic & Gulf Freight Conference Tariff No. 33 by the Federal Maritime Commission. One suspension insulator occupies .403 cubic feet (1/6 of 2.42 cubic feet). Ocean freight is therefore $.3176 per insulator. Calculation of the other costs of entry was similar.

Marine insurance: A shopping survey was conducted among insurance companies in New York City. The rate used was obtained from D. Hansen Inc., 8 Bridge Street, New York, a customs broker. The minimum rate including breakage was $.40/$100. This rate covers the FOB value of the product, plus duty, freight, clearing and customs bond.

Customs bond: The rate for the Customs guarantee bond was obtained from the same source as the information on marine insurance. In each case, the cost asked for was for a $100,000 shipment of palletized porcelain insulators. Customs guarantee bond rates were quoted at $.50/$1,000 per entry or $3/$1,000 annually on a term basis.

Pier handling: The stevedoring unit of the United States Line Co. (One Broadway, New York) reported pier handling charges were $.095/100 lbs. for palletized insulators when each pallet weighs more than 2,000 lbs.

FOB price Nagoya: Derived by dividing the duty paid per insulator as shown on TVA contracts by the tariff rate for TSUS 535.1100 — 15 percent ad valorem.

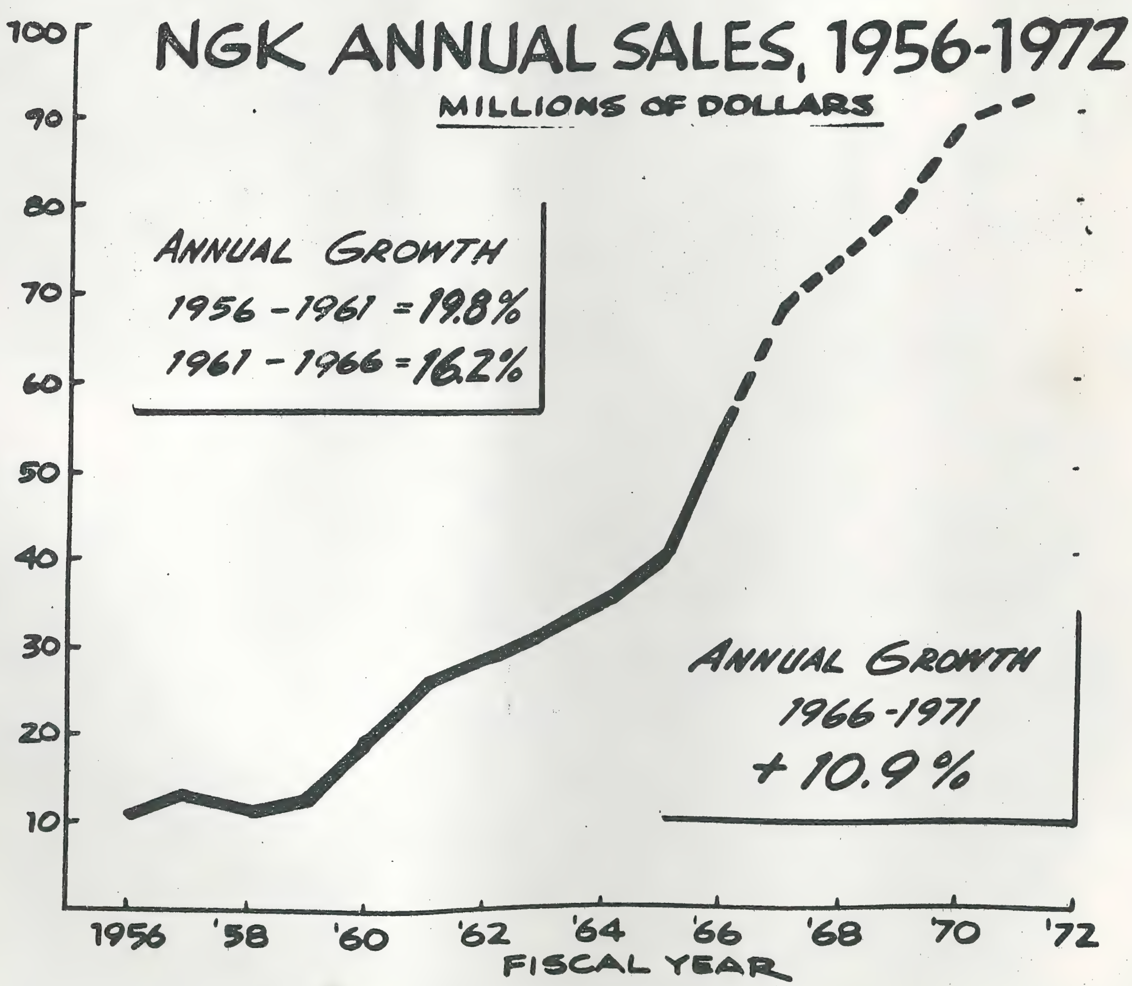
Mitsubishi's commission: According to the President of NGK America, Mr. P. Y. Matsura, Mitsubishi receives a flat commission of about 5 percent for its work in bringing insulators to the U. S. This commission rate is in line with Mitsubishi fees for similar services rendered in connection with the importation of similar products.

NGK America's operating expenses: The difference between the delivered price to TVA and the sum of the FOB Nagoya price plus all the adders is $0.0476. Since there are no other adjustments to be taken into account other than NGK America's selling expenses and profits, these items must account for the difference. Stated as a percent of sales, NGK expenses equal 2.9 percent of the FOB price. NGK America's sales on an FOB basis were about $11 million in 1967; three percent of that is $330,000. This is not an unreasonable budget for operating an organization of 25 people in six offices around the United States. It does not leave much for profits.

Thus, NGK's profits are limited solely to those earned by the parent company in Japan; these are included in the FOB price.

THE U. S. STAKE IN FAIR COMPETITION

If unfair competition does exist, it is imperative that it cease now. NGK has submitted to MITI projected sales in 1971 of $92 million. In view of the Japanese stress on exports, NGK will try very hard to meet their goal. Total NGK sales of $92 million would mean at current ratios (exports 56 percent, domestic sales 44 percent) exports of about $52 million. If the U. S. gets even half of these exports, it would be $26 million on FOB basis, or about $39 million on full price basis. This means that by 1971 imports from Japan would be double what they are now. Unless U. S. producers' sales also double,



Japan's share of the U. S. market will rise abruptly. For example, if the total U. S. market were to rise 50 percent above 1966 and NGK held to its export projections, their share of the U. S. market in 1971 would be 27 percent instead of their present 17 percent. If the U. S. market increases only 25 percent, NGK's share would be 31 percent.

There is another reason for making sure Japanese imports are priced fairly. French and Italian manufacturers, in order to sell in this country, have to meet NGK prices. If NGK is made to raise prices 23 percent, it is likely that French and Italian manufacturers' prices would follow.

U. S. MANUFACTURERS' DOMESTIC SALES OF
HIGH VOLTAGE PORCELAIN INSULATORS
INCLUDING INTERPLANT TRANSFERS

1956	$42,171*
1957	44,285*
1958	35,987*
1959	40,232*
1960	41,238
1961	42,308
1962	40,855
1963	41,640
1964	46,777
1965	65,669
1966	76,455
1967	77,842

Source: NEMA

*Prior to 1960, NEMA did not collect data on interplant transfers. Total sales for 1956-1959 were estimated by assuming the relation of interplant transfers to total sales as remaining constant in the same proportion as 1960-1961 interplant transfers to total sales.

HIGH VOLTAGE PORCELAIN INSULATORS
1967 MANUFACTURERS' DOMESTIC SALES

	All Domestic Sales	Interplant Transfers	Sales Net of Transfer
Guy Strain and Spool Type Insulators	$ 900,734	$ 62,203	$ 838,531
Low-Voltage One-Piece Pintype Insulators	3,212,077	109,679	3,102,398
High-Voltage Pintype Insulators	8,997,744	86,861	8,910,383
Suspension Insulators disc diameter 7-1/2" and smaller	8,070,756	360,225	7,710,531
disc diameter larger than 7-1/2"	23,603,105	164,271	23,438,834
Switch and Bus Insulators (Cap and Pin and Post Types)	22,304,074	1,935,162	20,368,912
All Porcelain Only Pieces	10,753,610	5,927,009	4,820,601
Total	$77,842,100	$8,645,410	$69,196,690

Source: NEMA Statistical Department

U. S. IMPORTS OF HIGH VOLTAGE PORCELAIN INSULATORS

All Countries and Japan, 1963-1967

Year	TSUS No. 535.1100	TSUS No. 535.1430	TSUS No. 535.1460	Total	
Imports from All Countries					
1963	$ 354,186	$ 55,511	$ 49,179	$ 458,876	Four months, Sept-Dec
	1,062,588	166,533	147,537	1,376,628	Annualized Total
1964	1,292,117	451,980	98,850	1,842,947	
1965	2,729,399	921,361	683,356	4,334,116	
1966	9,649,087	567,470	3,415,714	13,632,271	
1967	8,936,586	470,456	11,408,198	13,815,240	
Imports from Japan					
1963	$ 350,837	$ 38,628	$ 19,686	$ 409,151	Four months, Sept-Dec
	1,052,511	115,884	59,058	1,227,453	Annualized Total
1964	1,275,071	430,274	77,580	1,782,925	
1965	2,580,102	898,751	675,245	4,154,098	
1966	8,255,085	498,522	3,261,006	12,014,613	
1967	7,069,029	325,742	3,929,455	11,324,226	
Japan's Share of Total Imports					
1963	99.1%	69.6%	40.0%	89.1%	
1964	98.7	95.2	78.5	96.7	
1965	94.5	97.5	98.8	95.8	
1966	85.6	87.8	95.5	88.1	
1967	79.1	69.2	89.1	82.0	

Source: U. S. Bureau of the Census.

UNITED STATES TARIFF CLASSIFICATIONS FOR HIGH VOLTAGE PORCELAIN INSULATORS

Imports of high voltage insulators are separated into two groups for duty purposes (TSUS 535.11 and 535.14) and three groups for statistical purposes (TSUS 535.1100, 535.1430, and 535.1460). The Customs Bureau is concerned primarily with the collection of duties and only secondarily with the collection of statistics. The paragraphs below detail the problems which have arisen from the differences between the classifications for duty purposes and statistical purposes.

Item 535.1100, Tariff Schedules of the United States, Annotated (TSUSA), includes:

> Porcelain insulators, with metal parts cemented thereto and comprising not less than 30 per cent of the weight thereof, used in high-voltage, low-frequency electrical systems...

Included in this classification are suspension insulators, some post insulators, and bushing shells (depending on the weight of the metal parts of each).

Since all electrical power in the U. S. is generated at less than 100 cycles per second, all other insulators for transmission or distribution of electrical power should be included in Item 535.1430, TSUSA, which includes:

> Insulators designed for direct current, or for alternating current with frequencies not more than 100 cycles per second...

According to statements by officials at the New York Customs House, however, unless the customs invoice specifically includes all the information necessary to identify a product precisely within the language of Item 535.1430,

it is counted in Item 535.1460,[1] a much broader category. Item 535.1460 also includes insulators for use in radio and television transmission systems.

According to U. S. manufacturers of insulators for such systems, however, the amount of imports reported under 535.1460 is too great to reflect imports of insulators for radio and television. It is likely, therefore, that a substantial portion of 535.1460 represents imports of high voltage porcelain insulators for transmission and distribution of power. Therefore, the import statistics presented in this report include imports under 535.1460. In 1967, imports from all countries reported in the three classes (535.1100, 535.1430, 535.1460) totaled $13.8 million. If TSUSA 535.1460 is excluded, 1967 imports totalled $9.4 million — 31.9 percent less.

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1 Item 535.1460 TSUSA includes "other insulators," i.e., insulators not included in Items 535.1100 or 535.1430.

U. S. IMPORTS OF HIGH VOLTAGE PORCELAIN INSULATORS
FROM JAPAN, BY REGION, TSUS 535.1100
(VALUE BASIS)

	1964	1967
Western	64.2%	52.0%
Portland	16.1	14.7
Seattle	33.9	4.8
San Francisco	6.6	9.6
Los Angeles	7.6	22.9
Eastern	9.9%	29.0%
New York	9.8	9.1
Philadelphia	.1	11.2
Boston	-	1.3
Baltimore	-	5.5
Norfolk	-	1.9
Southern	22.2%	11.9%
New Orleans	20.3	6.1
Galveston (Houston)	1.9	3.6
Tampa (Miami)	-	1.2
Mobile	-	1.0
San Juan	3.5%	1.6%
Other	.2%	5.5%
Total	100.0%	100.0%

JAPANESE PRODUCTION, DOMESTIC SALES, EXPORT & TOTAL SALES OF THE PORCELAIN COMPONENTS FOR SPECIAL HIGH VOLTAGE* PORCELAIN INSULATORS

(Metric Tons)

Year	Production	Total Sales	Export Sales	Domestic Sales
1955	12,709	13,026	5,747	7,279
1956	17,344	16,052	6,142	9,911
1957	20,981	21,010	5,854	15,156
1958	20,303	20,627	8,242	12,385
1959	18,728	18,676	7,416	11,214
1960	23,306	23,114	7,366	15,747
1961	29,043	27,615	7,016	20,599
1962	33,082	30,345	14,508	15,836
1963	34,515	34,626	20,864	13,764
1964	34,120	32,209	18,666	13,544
1965	34,401	33,005	17,816	15,189
1966	45,110	44,148	24,982	19,165

*Defined by Japanese law as insulators for use on systems operating above 7,000 volts A. C. or D. C.

Source: 1966 from Year Book of General Merchandise Statistics (Daily Necessaries, Pottery and Glassware), Research and Statistics Division, Ministry of International Trade and Industry (MITI).
1955-1965 from Year Book of Ceramic Statistics, MITI.

JAPANESE PRODUCTION, DOMESTIC SALES, EXPORT & TOTAL SALES OF THE PORCELAIN COMPONENTS FOR SPECIAL HIGH VOLTAGE* PORCELAIN INSULATORS

(Dollars)

Year	Production	Total Sales	Export Sales	Domestic Sales
1955	$ 6, 126, 891	$ 6,283, 461	$ 2, 601, 245	$ 3, 682, 216
1956	8, 379, 725	7, 806, 251	2, 714, 649	5, 091, 602
1957	10, 340, 380	10, 281, 757	2, 749, 778	7, 531, 980
1958	10, 435, 528	10, 681, 191	4, 015, 265	6, 665, 926
1959	9, 461, 628	9, 409, 203	3, 320, 382	6, 088, 821
1960	14, 425, 163	14, 655, 620	3, 780, 114	10, 875, 506
1961	18, 583, 124	18, 348, 858	3, 765, 458	14, 583, 400
1962	19, 569, 926	18, 213, 165	6, 806, 199	11, 406, 966
1963	19, 010, 474**	19, 589, 509	9, 862, 159	9, 727, 350
1964	18, 546, 059	18, 077, 984	8, 339, 014	9, 738, 970
1965	21, 113, 913	21, 944, 203	9, 111, 940	12, 832, 264
1966	25, 915, 143	28, 027, 249	12, 936, 228	15, 091, 021

* Defined by Japanese law as insulators for use on systems operating above 7, 000 volts A. C. or D. C.

**Listed as $16, 793, 790 in 1965 Source.

Source: 1966 from Year Book of General Merchandise Statistics (Daily Necessaries, Pottery and Glassware), Research and Statistics Division, Ministry of International Trade and Industry (MITI). 1955 - 1965 from Year Book of Ceramic Statistics, MITI.

JAPANESE EXPORTS OF SPECIAL HIGH VOLTAGE INSULATORS
BY COUNTRY 1961 - 1966
(000 Dollars)

COUNTRY:	1961	1962	1963	1964	1965	1966
U. S.	169	565	1,069	1,927	5,420	10,532
India	1,010	3,253	6,140	2,626	824	--
Australia	740	936	670	996	1,404	1,415
Mexico	306	396	977	448	678	628
Pakistan	255	232	569	513	201	470
Canada	64	295	330	616	781	902
Sweden	229	311	275	283	570	--
W. Germany	144	297	322	340	377	--
Thailand	75	178	274	211	277	--
Others	1,422	2,000	2,303	3,331	3,398	5,385
TOTAL	4,414	8,463	12,929	11,291	13,930	19,332

Source: Foreign Trade of Japan, Japan External Trade Organization (JETRO) Annual.

The statistical series on Japanese exports in Foreign Trade in Japan are discontinuous. The data for 1964-1966 were derived by assuming the proportion of special high voltage insulators to total insulators was the same as in 1962 and 1963.

JAPANESE EXPORTS OF SPECIAL HIGH VOLTAGE INSULATORS
BY COUNTRY 1961 - 1966
(Percentage Distribution)

	1961	1962	1963	1964	1965	1966
COUNTRY:						
U. S.	3.8%	6.7%	8.3%	17.1%	38.9%	54.5%
India	22.9	38.4	47.5	23.3	5.9	--
Australia	16.8	11.1	5.2	8.8	10.1	7.3
Mexico	6.9	4.7	7.6	4.0	4.9	3.2
Pakistan	5.8	2.7	4.4	4.5	1.4	2.4
Canada	1.5	3.5	2.6	5.5	5.6	4.8
Sweden	5.2	3.7	2.1	2.5	4.1	--
W. Germany	3.3	3.5	2.5	3.0	2.7	--
Thailand	1.7	2.1	2.1	1.9	2.0	--
Others	32.1	23.6	17.7	29.4	24.4	27.9
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

NGK STATISTICS

The statistical information presented in this appendix is compiled primarily from the semi-annual reports submitted by NGK to the Government of Japan. The data cover ten six-month periods beginning with the six months ended in September, 196 . The latest data are for the six months ended March, 1967. The Government of Japan uses these reports in evaluating the performance of the Japanese economy and also the growth targets of individual firms. The statistics have been arranged in the following order:

Raw Material Prices

Purchases and Use of Raw Materials and Fuels

Employee Information

Details of Production Costs

Comparative Profit and Loss Statement

Distribution of Sales by Product and
by Export and Home Market Sales

Monthly Production, Capacity and Capacity Utilization

NGK Insulators, Ltd.

RAW MATERIAL PRICES*

DATE REPORTED:	Amakusa Pottery Stone	Gairome Clay	Kibushi Clay	Gypsum	Steel	Light Oil
April, 1962	$ 16.90	$ 23.89	$ 11.81	$ 47.22	$ 116.67	$ 36.94
Sept., 1962	16.90	23.89	13.75	47.22	116.67	36.94
June, 1963	16.90	24.92	17.86	47.22	116.67	36.94
Dec., 1963	17.32	24.92	17.86	47.22	116.67	36.94
March, 1964	17.32	25.47	17.86	47.22	116.67	36.94
March, 1965	19.24	25.47	17.86	52.78	116.67	36.67
Sept., 1965	19.07	25.47	17.86	50.00	116.67	34.72
March, 1966	19.07	27.11	17.86	50.00	116.67	32.78
June, 1966	20.46	27.78	17.86	50.00	116.67	32.78
Dec., 1966	20.46	27.78	17.86	55.56	116.67	30.56
March, 1967	20.46	30.28	17.86	55.56	119.45	30.56

*Note: All prices are dollars per ton, except light oil, which is expressed in dollars per kg.

NGK Insulators, Ltd.

PURCHASES AND USE OF RAW MATERIALS AND FUELS

	Six-Month Period Ending March 1967	Six-Month Period Ending Sept. 1966
RAW MATERIALS (Metric Tons)		
Pottery Stone and Feldspar		
Purchases	18,888	18,002
Use	18,843	15,680
Gairome Clay		
Purchases	8,536	8,521
Use	9,282	8,929
Kibushi Clay		
Purchases	1,850	1,579
Use	1,699	1,558
Gypsum		
Purchases	232	207
Use	229	207
Pig Iron		
Purchases	1,120	909
Use	1,120	909
Steel		
Purchases	4,503	2,536
Use	4,380	2,870
FUELS		
Coal (metric tons)		
Purchases	1,583	295
Use	1,173	453
Light Oil (kl)		
Purchases	13,091	11,747
Use	12,685	11,495
Electricity (000 kwh)		
Use	24,714	21,391

NGK Insulators, Ltd.

PURCHASES AND USE OF RAW MATERIALS AND FUELS

	Six-Month Period Ending March, 1966	Six-Month Period Ending Sept. 1965
RAW MATERIALS (Metric Tons)		
Pottery Stone and Feldspar		
Purchases	11,320	9,976
Use	13,714	13,670
Gairome Clay		
Purchases	5,712	4,157
Use	5,999	5,127
Kibushi Clay		
Purchases	2,117	2,157
Use	2,575	2,598
Gypsum		
Purchases	189	106
Use	177	148
Pig Iron		
Purchases	1,050	1,150
Use	1,050	1,150
Steel		
Purchases	3,164	1,909
Use	2,554	2,238
FUELS		
Coal (metric tons)		
Purchases	4,470	2,812
Use	4,396	3,119
Light Oil (kl)		
Purchases	9,711	7,870
Use	9,358	8,794
Electricity (000 kwh)		
Use	19,513	18,081

NGK Insulators, Ltd.

PURCHASES AND USE OF RAW MATERIALS AND FUELS

	Six-Month Period Ending March, 1965	Six-Month Period Ending Sept. 1964
RAW MATERIALS (Metric Tons)		
Pottery Stone and Feldspar		
Purchases	13,507	13,650
Use	12,566	12,353
Gairome Clay		
Purchases	4,715	5,223
Use	4,780	4,829
Kibushi Clay		
Purchases	2,516	2,846
Use	2,702	3,030
Gypsum		
Purchases	177	222
Use	172	238
Pig Iron		
Purchases	1,500	1,050
Use	1,500	1,050
Steel		
Purchases	1,800	2,109
Use	1,637	2,151
FUELS		
Coal (metric tons)		
Purchases	5,362	6,024
Use	5,783	7,088
Light Oil (kl)		
Purchases	8,485	8,558
Use	8,456	8,298
Electricity (000 kwh)		
Use	18,807	17,021

NGK Insulators, Ltd.

PURCHASES AND USE OF RAW MATERIALS AND FUELS

	Six-Month Period Ending March, 1964	Six-Month Period Ending Sept. 1963
RAW MATERIALS (Metric Tons)		
Pottery Stone and Feldspar		
Purchases	12,834	13,704
Use	12,537	12,831
Gairome Clay		
Purchases	4,641	5,626
Use	4,858	4,736
Kibushi Clay		
Purchases	2,495	2,865
Use	2,635	2,786
Gypsum		
Purchases	229	275
Use	253	274
Pig Iron		
Purchases	700	810
Use	700	810
Steel		
Purchases	2,285	2,521
Use	2,480	2,296
FUELS		
Coal (metric tons)		
Purchases	11,737	9,342
Use	11,610	9,105
Light Oil (kl)		
Purchases	8,532	8,915
Use	8,662	8,965
Electricity (000 kwh)		
Use	16,648	16,248

NGK Insulators, Ltd.

PURCHASES AND USE OF RAW MATERIALS AND FUELS

	Six-Month Period Ending March, 1963	Six-Month Period Ending Sept. 1962
RAW MATERIALS (Metric Tons)		
Pottery Stone and Feldspar		
Purchases	11,305	16,561
Use	14,126	13,188
Gairome Clay		
Purchases	4,203	7,787
Use	5,084	7,154
Kibushi Clay		
Purchases	3,100	3,758
Use	2,947	4,254
Gypsum		
Purchases	431	487
Use	437	500
Pig Iron		
Purchases	630	850
Use	630	850
Steel		
Purchases	2,107	2,224
Use	2,502	1,986
FUELS		
Coal (metric tons)		
Purchases	12,575	9,434
Use	12,356	9,360
Light Oil (kl)		
Purchases	9,028	9,452
Use	8,751	9,520
Electricity (000 kwh)		
Use	16,507	16,366

NGK Insulators, Ltd.

EMPLOYEE INFORMATION

	Six-Month Period Ending March, 1967	Six-Month Period Ending Sept. 1966
OFFICE PERSONNEL:		
Male		
Number of employees	1,221	1,129
Average age (years)	29.1	30.0
Average years employed	8.1	8.9
Average monthly salary	$ 149.50	$ 148.63
Female		
Number of employees	501	412
Average age (years)	22.9	23.0
Average years employed	4.2	4.2
Average monthly salary	78.39	77.56
Total Office		
Number of employees	1,722	1,541
Average age (years)	27.1	28.1
Average years employed	7.6	7.6
Average monthly salary	$ 130.52	$ 129.63
FACTORY PERSONNEL		
Male		
Number of employees	2,965	3,021
Average age (years)	29.4	28.3
Average years employed	8.8	7.6
Average monthly salary	$ 122.17	$ 121.36
Female:		
Number of employees	518	574
Average age (years)	22.1	21.1
Average years employed	5.1	4.9
Average monthly salary	$ 71.88	$ 72.20
Total Factory		
Number of employees	3,483	3,595
Average age (years)	28.4	27.3
Average years employed	8.3	7.1
Average monthly salary	$ 114.69	$ 113.51
ALL EMPLOYEES:		
Number of employees	5,205	5,136
Average age (years)	28.2	27.6
Average years employed	8.0	7.3
Average monthly salary	$ 119.53	$ 118.35

NGK Insulators, Ltd.

EMPLOYEE INFORMATION

	Six-Month Period Ending March, 1966	Six-Month Period Ending Sept. 1965
OFFICE PERSONNEL:		
Male		
Number of employees	1,011	1,012
Average age (years)	30.9	29.9
Average years employed	9.0	8.1
Average monthly salary	$ 135.06	$ 133.00
Female		
Number of employees	372	393
Average age (years)	23.7	22.3
Average years employed	4.8	3.9
Average monthly salary	$ 68.32	$ 66.32
Total Office		
Number of employees	1,383	1,405
Average age (years)	28.9	27.9
Average years employed	7.1	6.1
Average monthly salary	$ 117.11	$ 114.35
FACTORY PERSONNEL:		
Male		
Number of employees	3,072	3,102
Average age (years)	28.6	27.7
Average years employed	7.8	6.1
Average monthly salary	$ 99.59	$ 96.22
Female		
Number of employees	591	643
Average age (years)	22.7	21.6
Average years employed	5.4	4.5
Average monthly salary	59.24	57.40
Total Factory		
Number of employees	3,663	3,745
Average age (years)	27.6	26.6
Average years employed	7.4	6.5
Average monthly salary	$ 93.08	$ 89.55
ALL EMPLOYEES:		
Number of employees	5,046	5,150
Average age (years)	27.1	26.1
Average years employed	7.5	6.7
Average monthly salary	$ 99.67	$ 96.32

NGK Insulators, Ltd.

EMPLOYEE INFORMATION

	Six-Month Period Ending March, 1965	Six-Month Period Ending Sept. 1964
OFFICE PERSONNEL:		
Male		
Number of employees	907	899
Average age (years)	30.1	29.8
Average years employed	9.0	8.0
Average monthly salary	$ 127.60	$ 127.63
Female		
Number of employees	350	380
Average age (years)	23.9	22.7
Average years employed	4.8	3.9
Average monthly salary	$ 63.83	$ 60.93
Total Office		
Number of employees	1,257	1,279
Average age (years)	28.9	27.8
Average years employed	7.7	6.9
Average monthly salary	$ 109.84	$ 107.81
FACTORY PERSONNEL:		
Male		
Number of employees	2,895	2,909
Average age (years)	28.6	27.5
Average years employed	7.7	6.8
Average monthly salary	$ 90.26	$ 93.04
Female		
Number of employees	591	647
Average age (years)	22.9	21.7
Average years employed	5.4	4.5
Average monthly salary	$ 53.66	$ 55.34
Total Factory		
Number of employees	3,486	3,556
Average age (years)	27.6	26.4
Average years employed	7.2	6.3
Average monthly salary	$ 84.06	$ 86.18
ALL EMPLOYEES:		
Number of employees	4,743	4,835
Average age (years)	27.9	26.8
Average years employed	7.4	6.5
Average monthly salary	$ 90.89	$ 91.90

NGK Insulators, Ltd.

EMPLOYEE INFORMATION

	Six-Month Period Ending March, 1964	Six-Month Period Ending Sept. 1963
OFFICE PERSONNEL:		
Male		
Number of employees	867	836
Average age (years)	30.7	29.9
Average years employed	8.6	7.9
Average monthly salary	$ 112.62	$ 111.40
Female		
Number of employees	336	353
Average age (years)	23.9	22.9
Average years employed	4.8	3.8
Average monthly salary	$ 57.11	$ 53.76
Total Office		
Number of employees	1,203	1,189
Average age (years)	28.7	27.6
Average years employed	7.4	6.5
Average monthly salary	$ 97.11	$ 94.44
FACTORY PERSONNEL:		
Male		
Number of employees	2,821	2,828
Average age (years)	28.3	27.7
Average years employed	7.1	6.7
Average monthly salary	$ 86.33	$ 79.65
Female		
Number of employees	624	653
Average age (years)	22.5	21.7
Average years employed	4.1	4.2
Average monthly salary	$ 52.92	$ 48.15
Total Factory		
Number of employees	3,445	3,481
Average age (years)	27.2	26.3
Average years employed	6.7	6.1
Average monthly salary	$ 80.28	$ 73.74
ALL EMPLOYEES:		
Number of employees	4,648	4,670
Average age (years)	27.6	26.8
Average years employed	6.1	6.2
Average monthly salary	$ 84.64	$ 79.01

NGK Insulators, Ltd.

EMPLOYEE INFORMATION

	Six-Month Period Ending March, 1963	Six-Month Period Ending Sept. 1962
OFFICE PERSONNEL:		
Male		
Number of employees	714	733
Average age (years)	31.1	29.6
Average years employed	8.1	8.2
Average monthly salary	$ 112.67	$ 111.73
Female		
Number of employees	320	320
Average age (years)	23.6	22.6
Average years employed	4.3	3.1
Average monthly salary	$ 50.28	$ 52.05
Total Office		
Number of employees	1,034	1,053
Average age (years)	28.7	27.3
Average years employed	7.4	6.1
Average monthly salary	$ 90.58	$ 93.59
FACTORY PERSONNEL:		
Male		
Number of employees	2,535	2,476
Average age (years)	28.2	27.4
Average years employed	7.2	7.7
Average monthly salary	$ 73.42	$ 77.83
Female		
Number of employees	637	652
Average age (years)	22.3	21.4
Average years employed	4.9	4.6
Average monthly salary	$ 42.36	$ 45.05
Total Factory		
Number of employees	3,172	3,128
Average age (years)	26.9	26.1
Average years employed	6.7	7.0
Average monthly salary	$ 67.18	$ 71.00
ALL EMPLOYEES:		
Number of employees	4,206	4,181
Average age (years)	27.5	26.5
Average years employed	6.1	6.1
Average monthly salary	$ 73.62	$ 76.69

NGK Insulators, Ltd.

DETAILS OF PRODUCTION COSTS

	Six-Month Period Ending March, 1967	Sept. 1966
MATERIALS:		
Initial Inventory	$ 4,258,620	$ 4,368,585
Purchases	9,091,128	7,657,414
Total available materials	13,349,748	12,025,999
Final inventory	4,973,154	4,258,620
Total Materials Costs	$ 8,376,595	$ 7,767,379
LABOR:		
Salaries and wages	$ 3,134,311	$ 3,042,235
Wages of temporary employees	97,162	91,015
Employee bonuses	1,088,414	1,124,403
Pension reserve	565,143	436,092
Welfare expenses	443,720	447,081
Total Labor Costs	$ 5,328,751	$ 5,140,911
EXPENSES:		
Depreciation	$ 823,140	$ 762,820
Insurance	19,022	18,420
Maintenance	425,940	370,139
Electric, gas, & water power	412,801	353,331
Transportation	107,156	92,462
Taxes and public charges	89,465	89,245
Other purchases	157,121	138,798
Damage and abandonment	108,093	56,284
Other	242,102	208,049
Total Expenses	$ 2,384,839	$ 2,089,547
TOTAL FACTORY COSTS:	$16,090,185	$14,997,837
Expenses transferred to other accts.	(596,780)	(340,089)
Total production cost of goods	$15,493,405	$14,657,748
INVENTORY ADJUSTMENTS:		
Invty - goods in process beg/period	$ 570,043	$ 548,957
1/2 finished at beg/period	2,769,828	3,167,189
Invty - goods in process end/period	(626,505)	(570,043)
1/2 finished at end/period	(2,648,288)	(2,769,828)
COST OF PRODUCTS COMPLETED DURING PERIOD	$15,558,483	$15,034,023

NGK Insulators, Ltd.

DETAILS OF PRODUCTION COSTS

	Six-Month Period Ending March, 1966	Sept. 1965
MATERIALS:		
Initial Inventory	$ 3,719,716	$ 4,001,613
Purchases	6,701,995	5,955,625
Total available materials	10,421,711	9,957,238
Final inventory	4,368,585	3,719,716
Total Materials Costs	$ 6,053,126	$ 6,237,522
LABOR:		
Salaries and wages	$ 2,632,418	$ 2,537,040
Wages of temporary employees	71,470	104,268
Employee bonuses	832,304	857,176
Pension reserve	238,960	215,607
Welfare expenses	385,025	365,722
Total Labor Costs	$ 4,160,178	$ 4,079,813
EXPENSES:		
Depreciation	$ 1,044,181	$ 1,202,168
Insurance	18,186	17,597
Maintenance	289,652	193,085
Electric, gas, & water power	344,072	297,425
Transportation	73,578	63,028
Taxes and public charges	90,784	92,484
Other purchases	93,287	122,643
Damage and abandonment	108,484	58,300
Other	186,768	181,218
Total Expenses	$ 2,248,993	2,226,837
TOTAL FACTORY COSTS:	$12,462,297	$12,544,172
Expenses transferred to other accts.	(396,389)	(443,920)
Total production cost of goods	$12,065,908	$12,100,252
INVENTORY ADJUSTMENTS:		
Invty - goods in process beg/period	$ 522,076	$ 483,787
1/2 finished at beg/period	3,545,459	4,077,058
Invty - goods in process end/period	(548,957)	(522,076)
1/2 finished at end/period	(3,167,189)	(3,545,459)
COST OF PRODUCTS COMPLETED DURING PERIOD	$12,417,297	$12,593,562

NGK Insulators, Ltd.

DETAILS OF PRODUCTION COSTS

	Six-Month Period Ending March, 1965	Sept. 1964
MATERIALS:		
Initial Inventory	$ 4,036,480	$ 3,354,130
Purchases	5,607,498	6,821,588
Total available materials	9,643,977	10,175,718
Final inventory	4,001,613	4,036,480
Total Materials Costs	$ 5,642,365	$ 6,139,238
LABOR:		
Salaries and wages	$ 2,295,224	$ 2,362,855
Wages of temporary employees	169,582	144,793
Employee bonuses	619,072	688,211
Pension reserve	173,435	232,082
Welfare expenses	334,642	334,830
Total Labor Costs	$ 3,591,954	$ 3,762,772
EXPENSES:		
Depreciation	$ 1,185,684	$ 1,231,682
Insurance	17,331	12,622
Maintenance	226,007	156,587
Electric, gas & water power	274,924	253,519
Transportation	68,373	62,639
Taxes and public charges	73,409	68,564
Other purchases	129,165	126,912
Damage and abandonment	80,601	65,423
Other	195,168	174,921
Total Expenses	$ 2,250,662	$ 2,152,870
TOTAL FACTORY COSTS:	$11,484,981	$12,054,880
Expenses transferred to other accts.	(544,504)	(391,770)
Total production cost of goods	$10,940,476	$11,663,110
INVENTORY ADJUSTMENTS:		
Invty - goods in process beg/period	$ 452,881	$ 435,445
1/2 finished at beg/period	3,895,078	3,902,273
Invty - goods in process end/period	(483,787)	(452,881)
1/2 finished at end/period	(4,077,058)	(3,895,078)
COST OF PRODUCTS COMPLETED DURING PERIOD	$10,727,591	$11,652,868

NGK Insulators, Ltd.

DETAILS OF PRODUCTION COSTS

	Six-Month Period Ending March, 1964	Sept. 1963
MATERIALS:		
Initial Inventory	$ 3,594,909	$ 3,767,855
Purchases	5,759,174	5,832,286
Total available materials	9,354,083	9,600,141
Final inventory	3,354,130	3,594,909
Total Materials Costs	$ 5,999,954	$ 6,005,231
LABOR:		
Salaries and wages	$ 1,950,929	$ 1,904,585
Wages of temporary employees	97,092	163,560
Employee bonuses	637,911	440,420
Pension reserve	172,418	205,349
Welfare expenses	296,600	294,063
Total Labor Costs	$ 3,154,950	$ 3,007,977
EXPENSES:		
Depreciation	$ 847,768	$ 896,035
Insurance	11,058	12,689
Maintenance	139,290	148,421
Electric, gas & water power	248,658	225,021
Transportation	72,434	67,506
Taxes and public charges	71,412	71,284
Other purchases	272,280	125,451
Damage and abandonment	50,778	48,698
Other	152,351	154,129
Total Expenses	$ 1,866,029	$ 1,749,233
TOTAL FACTORY COSTS:	$11,020,933	$10,762,441
Expenses transferred to other accts.	(481,968)	(356,486)
Total production cost of goods	$10,538,965	$10,405,955
INVENTORY ADJUSTMENTS:		
Invty - goods in process beg/period	$ 418,778	$ 447,206
1/2 finished at beg/period	3,395,563	3,023,352
Invty - goods in process end/period	(435,445)	(418,778)
1/2 finished at end/period	(3,902,273)	(3,395,563)
COST OF PRODUCTS COMPLETED DURING PERIOD	$10,015,588	$10,062,172

NGK Insulators, Ltd.

DETAILS OF PRODUCTION COSTS

	Six-Month Period Ending March, 1963	Six-Month Period Ending Sept. 1962
MATERIALS:		
Initial inventory	$ 3,906,737	$ 3,600,320
Purchases	5,747,324	5,960,675
Total available materials	$ 9,654,061	$ 9,560,996
Final inventory	3,767,855	3,906,737
Total Materials Costs	$ 5,886,205	$ 5,654,259
LABOR:		
Salaries and wages	$ 1,645,810	$ 1,716,783
Wages of temporary employees	212,491	303,816
Employee bonuses	398,231	357,272
Pension reserve	144,512	(450,126
Welfare expenses	299,861	(
Total Labor Costs	$ 2,700,905	$ 2,827,998
EXPENSES:		
Depreciation	$ 916,266	$ 944,458
Insurance	14,700	17,808
Maintenance	144,768	157,721
Electric, gas & water power	234,755	237,530
Transportation	56,756	47,117
Taxes and public charges	65,403	67,751
Other purchases	80,798	130,559
Damage and abandonment	90,326	64,981
Other	162,112	162,518
Total Expenses	$ 1,765,884	$ 1,830,442
TOTAL FACTORY COSTS:	$10,352,994	$10,312,699
Expenses transferred to other accts.	(382,284)	(369,217)
Total production cost of goods	$ 9,970,710	$ 9,943,482
INVENTORY ADJUSTMENTS:		
Invty - goods in process beg/period	$ 386,811	$ 452,254
1/2 finished at beg/period	2,389,316	1,894,098
Invty - goods in process end/period	(447,206)	(386,811)
1/2 finished at end/period	(3,023,352)	(2,389,316)
COST OF PRODUCTS COMPLETED DURING PERIOD	$ 9,276,280	$ 9,513,707

NGK Insulators, Ltd.

DETAILS OF PRODUCTION COSTS

	Six-Month Period Ending March, 1962
MATERIALS:	
Initial Inventory	$ 3,011,446
Purchases	6,178,927
Total available materials	9,190,374
Final inventory	3,600,320
Total Materials Costs	$ 5,590,053
LABOR:	
Salaries and wages	$ 1,505,076
Wages of temporary employees	356,631
Employee bonuses	538,040
Pension reserve	(476,340
Welfare expenses	(
Total Labor Costs	$ 2,876,087
EXPENSES:	
Depreciation	$ 771,551
Insurance	16,900
Maintenance	314,675
Electric, gas & water power	242,538
Transportation	46,581
Taxes and public charges	37,534
Other purchases	141,809
Damage and abandonment	72,031
Other	165,354
Total Expenses	$ 1,808,973
TOTAL FACTORY COSTS:	$10,275,113
Expenses transferred to other accts.	(335,842)
Total production cost of goods	$ 9,939,271
INVENTORY ADJUSTMENTS:	
Invty - goods in process beg/period	$ 324,500
1/2 finished at beg/period	1,327,366
Invty - goods in process end/period	(452,254)
1/2 finished at end/period	(1,894,098)
COST OF PRODUCTS COMPLETED DURING PERIOD	$ 9,244,785

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

	Six-Month Period Ending March, 1967	Six-Month Period Ending Sept. 1966
SALES:		
Gross sales	$ 29,330,374	$ 27,086,214
Less: Discounts & Returned Goods	241,532	273,116
Net Sales	$ 29,088,841	$ 26,813,098
COST OF GOODS SOLD:		
Initial Inventory	$ 3,849,984	$ 3,537,306
Cost of products completed	15,558,483	15,034,023
Purchased goods	4,887,375	4,088,977
Goods available for sale	24,295,842	22,660,306
Less: Final Inventory	3,993,740	3,849,984
Cost of Goods Sold	20,302,101	18,810,323
GROSS PROFIT	$ 8,786,740	$ 8,002,775
SELLING & ADMINISTRATIVE EXPENSES:		
Transportation	$ 1,519,576	$ 1,436,545
Sales commissions	425,359	421,309
Advertising	65,398	33,395
Communication	164,637	145,596
Travel	177,454	156,268
Social	171,551	133,784
Officers' salaries	139,721	125,309
Salaries & wages	550,207	515,835
Employee bonuses	194,099	176,551
Pension reserve	60,928	70,067
Welfare expenses	72,964	69,134
Depreciation	26,864	29,570
Taxes & public charges	5,858	6,961
Maintenance	51,898	33,392
Rent	60,623	27,231
Other	389,836	325,086
Total Selling & Admin. Expenses	4,076,974	3,706,032
OPERATING PROFIT	$ 4,709,765	$ 4,296,743

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

Continued	Six-Month Period Ending March, 1967	Six-Month Period Ending Sept. 1966
OTHER INCOME:		
Interest	$ 277,508	$ 290,655
Dividends	253,824	208,593
Profit on distribution of raw materials	41,828	163,712
Other	191,465	159,779
Total Other Income	$ 764,626	$ 822,740
GROSS INCOME	$ 5,474,391	$ 5,119,483
OTHER EXPENSES:		
Interest paid	$ 846,429	$ 976,472
Tax reserve transfer	361,114	361,114
Inventory loss	235,844	240,910
Special repayment of Fixed Assets	647,605	360,295
Other	412,451	507,462
Total Other Expenses	$ 2,503,442	$ 2,446,253
NET INCOME BEFORE TAXES	$ 2,970,949	$ 2,673,230
TAXES	1,055,564	1,027,786
NET INCOME	$ 1,915,385	$ 1,645,444

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

	Six-Month Period Ending March, 1966	Six-Month Period Ending Sept. 1965
SALES:		
Gross sales	$ 21,001,860	$ 19,136,548
Less: Discounts & Returned Goods	287,322	214,952
Net Sales	$ 20,714,538	$ 18,921,596
COST OF GOODS SOLD:		
Initial Inventory	$ 2,920,873	$ 1,957,668
Cost of products completed	12,417,297	12,593,562
Purchased goods	3,074,561	2,089,522
Goods available for sale	18,412,731	16,640,753
Less: Final Inventory	3,537,306	2,920,873
Cost of Goods Sold	14,875,425	13,719,879
GROSS PROFIT	$ 5,839,113	$ 5,201,717
SELLING & ADMINISTRATIVE EXPENSES:		
Transportation	$ 1,047,153	$ 1,078,373
Sales commissions	396,189	377,445
Advertising	55,350	55,809
Communication	133,329	108,073
Travel	149,843	142,104
Social	132,618	84,028
Officers' salaries	102,115	103,573
Salaries & wages	430,723	424,612
Employee bonuses	132,126	126,645
Pension reserve	44,809	48,353
Welfare expenses	72,142	69,348
Depreciation	28,439	36,228
Taxes & public charges	5,603	5,761
Maintenance	23,075	17,953
Rent	26,381	26,811
Other	266,299	236,010
Total Selling & Admin. Expenses	3,046,194	2,941,126
OPERATING PROFIT	$ 2,792,920	$ 2,260,590

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

Continued

	Six-Month Period Ending March, 1966	Six-Month Period Ending Sept. 1965
OTHER INCOME:		
Interest	$ 227,193	$ 156,123
Dividends	244,891	203,282
Profit on distribution of raw materials	57,328	32,825
Other	112,009	109,415
Total Other Income	$ 641,422	$ 501,646
GROSS INCOME	$ 3,434,341	$ 2,762,236
OTHER EXPENSES:		
Interest paid	$ 1,021,758	$ 1,101,295
Tax reserve transfer	205,557	138,890
Inventory loss	79,570	42,395
Special repayment of Fixed Assets	-	-
Other	281,808	153,637
Total Other Expenses	$ 1,588,693	$ 1,436,217
NET INCOME BEFORE TAXES	$ 1,845,648	$ 1,326,019
TAXES	$ 563,893	$ 341,669
NET INCOME	$ 1,281,755	$ 984,350

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

	Six-Month Period Ending March, 1965	Six-Month Period Ending Sept. 1964
SALES:		
Gross sales	$ 17,657,325	$ 17,448,476
Less: Discounts & Returned Goods	172,721	223,616
Net Sales	$ 17,484,604	$ 17,224,860
COST OF GOODS SOLD:		
Initial Inventory	$ 2,157,117	$ 1,694,286
Cost of products completed	10,727,591	11,652,868
Purchased goods	1,893,429	1,474,981
Goods available for sale	14,778,138	14,822,135
Less: Final Inventory	1,957,668	2,157,117
Cost of Goods Sold	12,820,469	12,665,018
GROSS PROFIT	$ 4,664,135	$ 4,559,842
SELLING & ADMINISTRATIVE EXPENSES:		
Transportation	$ 795,801	$ 847,715
Sales commissions	303,419	416,581
Advertising	34,881	35,045
Communication	113,304	104,215
Travel	164,771	156,404
Social	127,423	107,526
Officers' salaries	103,240	102,487
Salaries & wages	373,317	373,122
Employee bonuses	114,726	123,779
Pension reserve	33,825	37,075
Welfare expenses	67,398	53,964
Depreciation	33,334	36,628
Taxes & Public charges	5,156	6,283
Maintenance	19,281	10,300
Rent	26,484	25,764
Other	229,657	242,176
Total Selling & Admin. Expenses	2,546,015	2,679,066
OPERATING PROFIT	$ 2,118,120	$ 1,880,776

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

Continued

	Six-Month Period Ending March, 1965	Six-Month Period Ending Sept. 1964
OTHER INCOME:		
Interest	$ 153,646	$ 118,020
Dividends	171,774	161,585
Profit on distribution of raw materials	20,608	40,864
Other	102,101	92,362
Total Other Income	$ 448,129	$ 412,831
GROSS INCOME	$ 2,566,248	$ 2,293,607
OTHER EXPENSES:		
Interest paid	$ 1,041,169	$ 928,882
Tax reserve transfer	137,501	94,445
Inventory loss	50,381	-
Special repayment of Fixed Assets	-	-
Other	134,234	99,592
Total Other Expenses	$ 1,363,286	$ 1,122,920
NET INCOME BEFORE TAXES	$ 1,202,962	$ 1,170,687
TAXES	333,336	202,779
NET INCOME	$ 869,626	$ 967,908

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

	Six-Month Period Ending March, 1964	Six-Month Period Ending Sept. 1963
SALES:		
Gross Sales	$ 15,707,965	$ 15,140,835
Less: Discounts & Returned Goods	140,776	124,679
Net Sales	$ 15,567,188	$ 15,016,156
COST OF GOODS SOLD:		
Initial Inventory	$ 1,832,801	$ 1,957,038
Cost of products completed	10,015,588	10,062,172
Purchased goods	1,008,419	436,737
Goods available for sale	12,856,808	12,455,947
Less: Final Inventory	1,694,286	1,832,801
Cost of Goods Sold	11,148,634	10,623,146
GROSS PROFIT	$ 4,404,666	$ 4,393,010
SELLING & ADMINISTRATIVE EXPENSES:		
Transportation	$ 764,042	$ 784,578
Sales commissions	219,382	239,677
Advertising	37,489	37,539
Communication	92,951	83,856
Travel	151,832	133,482
Social	120,170	97,876
Officers' salaries	96,712	88,292
Salaries & wages	351,936	351,650
Employee bonuses	124,476	90,492
Pension reserve	29,959	36,261
Welfare expenses	51,317	51,592
Depreciation	24,414	24,628
Taxes & public charges	6,514	5,792
Maintenance	11,328	10,578
Rent	22,297	23,775
Other	257,283	240,388
Total Selling & Admin. Expenses	2,362,102	2,300,457
OPERATING PROFIT	$ 2,042,564	$ 2,098,108

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

Continued

	Six-Month Period Ending March, 1964	Six-Month Period Ending Sept. 1963
OTHER INCOME:		
Interest	$ 143,818	$ 146,843
Dividends	155,479	156,393
Profit on distribution of raw materials	30,589	28,659
Other	76,253	66,937
Total Other Income	$ 406,139	$ 398,831
GROSS INCOME	$ 2,448,703	$ 2,491,384
OTHER EXPENSES:		
Interest paid	$ 966,619	$ 1,077,261
Tax reserve transfer	147,223	138,890
Inventory loss	35,223	21,078
Special repayment of Fixed Assets	-	-
Other	115,351	92,856
Total Other Expenses	$ 1,264,416	$ 1,330,086
NET INCOME BEFORE TAXES	$ 1,184,287	$ 1,161,298
TAXES	277,780	263,891
NET INCOME	$ 906,507	$ 897,407

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

	Six-Month Period Ending March, 1963	Six-Month Period Ending Sept. 1962
SALES:		
Gross Sales	$14,150,313	$14,108,282
Less: Discounts & Returned Goods	117,179	140,629
Net Sales	$14,033,134	$13,967,653
COST OF GOODS SOLD:		
Initial Inventory	$ 1,982,585	$ 1,469,578
Cost of products completed	9,276,280	9,513,707
Purchased goods	364,286	352,522
Goods available for sale	11,623,151	11,335,807
Less: Final Inventory	1,957,038	1,982,585
Cost of Goods Sold	9,666,113	9,353,222
GROSS PROFIT	$ 4,367,021	$ 4,614,431
SELLING & ADMINISTRATIVE EXPENSES:		
Transportation	$ 787,395	$ 650,333
Sales commissions	324,155	285,672
Advertising	58,925	57,798
Communication	83,698	68,159
Travel	116,820	91,195
Social	129,229	116,779
Officers' salaries	92,706	94,598
Salaries & wages	300,558	299,636
Employee bonuses	80,256	78,181
Pension reserve	24,686	24,797
Welfare expenses	50,998	33,772
Depreciation	27,100	24,303
Taxes & public charges	8,317	8,014
Maintenance	9,825	10,683
Rent	20,672	16,370
Other	266,754	257,175
Total Selling & Admin. Expenses	2,382,097	2,117,464
OPERATING PROFIT	$ 1,984,924	$ 2,496,967

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

Continued

	Six-Month Period Ending March, 1963	Six-Month Period Ending Sept. 1962
OTHER INCOME:		
Interest	$ 200,202	$ 134,909
Dividends	150,423	140,587
Profit on distribution of raw materials	33,159	22,603
Other	83,973	66,639
Total Other Income	$ 467,757	$ 364,739
GROSS INCOME	$ 2,452,681	$ 2,861,706
OTHER EXPENSES:		
Interest paid	$ 1,168,962	$ 1,050,836
Tax reserve transfer	103,554	207,657
Inventory loss	16,422	9,111
Special repayment of Fixed Assets	-	-
Other	196,546	206,368
Total Other Expenses	$ 1,485,484	$ 1,473,973
NET INCOME BEFORE TAXES	$ 967,197	$ 1,387,733
TAXES	225,002	291,669
NET INCOME	$ 742,195	$ 1,096,064

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

	Six-Month Period Ending March, 1962
SALES	
Gross Sales	$13,595,284
Less: Discounts & Returned Goods	184,176
Net Sales	$13,411,107
COST OF GOODS SOLD:	
Initial Inventory	$ 1,132,884
Cost of products completed	9,244,785
Purchased Goods	180,913
Goods available for sale	10,558,582
Less: Final Inventory	1,469,578
Cost of Goods Sold	9,089,003
GROSS PROFIT	$ 4,322,104
SELLING & ADMINISTRATIVE EXPENSES:	
Transportation	$ 468,012
Sales commissions	191,410
Advertising	39,995
Communication	61,017
Travel	94,798
Social	133,168
Officers' salaries	92,567
Salaries & wages	241,755
Employee bonuses	123,482
Pension reserve	32,703
Welfare expenses	36,045
Depreciation	33,039
Taxes & public charges	7,603
Maintenance	18,872
Rent	14,770
Other	216,399
Total Selling & Admin. Expenses	1,805,634
OPERATING PROFIT	$ 2,516,470

NGK Insulators, Ltd.

COMPARATIVE PROFIT AND LOSS STATEMENT

Continued

	Six-Month Period Ending March, 1962
OTHER INCOME:	
Interest	$ 92,501
Dividends	111,006
Profit on distribution of raw materials	21,242
Other	154,515
Total Other Income	$ 379,264
GROSS INCOME	$ 2,895,734
OTHER EXPENSES:	
Interest paid	$ 687,294
Tax reserve transfer	243,483
Inventory loss	48,336
Special repayment of Fixed Assets	-
Other	254,049
Total Other Expenses	$ 1,233,163
NET INCOME BEFORE TAXES	$ 1,662,572
TAXES	508,337
NET INCOME	$ 1,154,234

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending March, 1967		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	21,499	$ 11,944,034	41.1%
Chemical industry machinery & equipment	2,128	2,175,734	7.5
Special metals & ceramics	198	1,844,470	6.3
Total domestic	23,825	$ 15,964,239	54.9%
EXPORT SALES:			
Insulators	23,776	$ 12,944,623	44.5%
Chemical industry machinery & equipment	144	145,754	0.5
Special metals & ceramics	4	34,225	0.1
Total export	23,924	$ 13,124,602	45.1%
TOTAL SALES	47,749	$ 29,088,841	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending Sept. 1966		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	19,325	$ 10,950,760	40.8%
Chemical industry machinery & equipment	1,446	1,425,459	5.3
Special metals & ceramics	154	1,320,369	5.0
Total domestic	20,925	$ 12,196,575	51.1%
EXPORT SALES:			
Insulators	22,927	$ 12,800,752	47.7%
Chemical industry machinery & equipment	294	289,013	1.1
Special metals & ceramics	3	26,745	0.1
Total export	23,224	$ 13,116,510	48.9%
TOTAL SALES	44,149	$26,813,098	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

Six-Month Period Ending March, 1966

	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	17,006	$ 9,400,684	45.4%
Chemical industry machinery & equipment	1,850	1,849,681	8.9
Special metals & ceramics	128	1,055,775	5.1
Total domestic	18,984	$ 12,306,140	59.4%
EXPORT SALES:			
Insulators	15,136	$ 8,282,725	40.0%
Chemical industry machinery & equipment	111	109,295	0.5
Special metals & ceramics	3	16,378	0.1
Total export	15,250	$ 8,408,398	40.6%
TOTAL SALES	34,234	$ 20,714,538	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending Sept. 1965		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	13,634	$ 7,574,413	40.0%
Chemical industry machinery & equipment	1,560	1,702,500	9.0
Special metals & ceramics	179	1,390,294	7.4
Total domestic	15,373	$ 10,667,208	56.4%
EXPORT SALES:			
Insulators	14,720	$ 8,099,159	42.8%
Chemical industry machinery & equipment	134	137,701	0.7
Special metals & ceramics	1	17,528	0.1
Total export	14,855	$ 8,254,388	43.6%
TOTAL SALES	30,228	$ 18,921,596	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending March, 1965		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	14,616	$ 7,389,056	42.3%
Chemical industry machinery & equipment	1,908	2,066,672	11.8
Special metals & ceramics	187	1,507,523	8.6
Total domestic	16,711	$ 10,963,252	62.7%
EXPORT SALES:			
Insulators	12,845	$ 6,422,574	36.7%
Chemical industry machinery & equipment	91	88,717	0.5
Special metals & ceramics	1	10,061	0.1
Total export	12,937	$ 6,521,352	37.3%
TOTAL SALES	29,648	$ 17,484,604	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending Sept. 1964		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	12,989	$ 6,674,990	38.8%
Chemical industry machinery & equipment	1,314	1,639,871	9.5
Special metals & ceramics	121	1,507,123	8.7
Total domestic	14,424	$ 9,821,984	57.0%
EXPORT SALES:			
Insulators	13,777	$ 7,080,134	41.1%
Chemical industry machinery & equipment	303	304,872	1.8
Special metals & ceramics	2	17,870	0.1
Total export	14,082	$ 7,402,876	43.0
TOTAL SALES	28,506	$ 17,224,860	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending March, 1964		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	11,495	$ 6,150,713	39.5%
Chemical industry machinery & equipment	1,984	1,309,980	8.4
Special metals & ceramics	78	724,078	4.7
Total domestic	13,557	$ 8,184,771	52.6%
EXPORT SALES:			
Insulators	13,123	$ 7,142,960	45.8%
Chemical industry machinery & equipment	407	230,502	1.5
Special metals & ceramics	1	8,956	0.1
Total export	13,531	$ 7,382,417	47.4%
TOTAL SALES	27,088	$ 15,567,188	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending Sept. 1963		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	11,334	$ 6,391,076	42.6%
Chemical industry machinery & equipment	2,009	1,026,853	6.8
Special metals & ceramics	95	632,955	4.2
Total domestic	13,438	$ 8,050,884	53.6%
EXPORT SALES:			
Insulators	12,417	$ 6,898,441	46.0
Chemical industry machinery & equipment	120	65,734	0.4
Special metals & ceramics	-	1,097	-
Total export	12,537	$ 6,965,272	46.4%
TOTAL SALES	25,975	$ 15,016,156	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending March, 1963		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	8,946	$ 5,044,782	36.0%
Chemical industry machinery & equipment	1,626	903,360	6.4
Special metals & ceramics	89	626,288	4.5
Total domestic	10,661	$ 6,574,430	46.9%
EXPORT SALES:			
Insulators	13,093	$ 7,383,326	52.6%
Chemical industry machinery & equipment	118	70,226	0.5
Special metals & ceramics	1	5,153	-
Total export	13,212	$ 7,458,704	53.1%
TOTAL SALES	23,873	$ 14,033,134	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending Sept. 1962		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	11,931	$ 6,667,051	47.8%
Chemical industry machinery & equipment	2,584	1,080,503	7.7
Special metals & ceramics	63	365,461	2.6
Total domestic	14,578	$ 8,113,015	58.1%
EXPORT SALES:			
Insulators	10,016	$ 5,556,536	39.8%
Chemical industry machinery & equipment	213	255,696	1.8
Special metals & ceramics	-	42,406	0.3
Total export	10,229	$ 5,854,639	41.9%
TOTAL SALES	24,807	$ 13,967,653	100.0%

NGK Insulators, Ltd.

DISTRIBUTION OF SALES BY PRODUCT

Domestic & Export Sales

	Six-Month Period Ending March, 1962		
	Quantity (metric tons)	Value	Percent of Total Sales
DOMESTIC SALES:			
Insulators	14,193	$ 8,719,245	65.0%
Chemical industry machinery & equipment	2,177	921,743	6.9
Special metals & ceramics	47	244,994	1.8
Total domestic	16,417	$ 9,885,982	73.7%
EXPORT SALES:			
Insulators	5,329	$ 3,271,804	24.4%
Chemical industry machinery & equipment	135	250,435	1.9
Special metals & ceramics	1	2,886	-
Total export	5,465	$ 3,525,125	26.3%
TOTAL SALES	21,882	$ 13,411,107	100.0%

NGK Insulators, Ltd.

MONTHLY PRODUCTION, CAPACITY & CAPACITY UTILIZATION
(Metric Tons)

	Six-Month Period Ending March, 1967	Six-Month Period Ending Sept. 1966
INSULATORS:		
Production	6,052	5,752
Capacity	6,300	6,300
Capacity Utilization	96%	91%
CHEMICAL INDUSTRY MACHINERY & EQUIPMENT:		
Production	250	192
Capacity	350	350
Capacity Utilization	71%	55%
SPECIAL METALS & CERAMICS:		
Production	40	16
Capacity	43	25
Capacity Utilization	93%	64%
TOTAL:		
Production	6,342	5,960
Capacity	6,693	6,675
Capacity Utilization	95%	89%

NGK Insulators, Ltd.

MONTHLY PRODUCTION, CAPACITY & CAPACITY UTILIZATION
(Metric Tons)

	Six-Month Period Ending March, 1966	Six-Month Period Ending Sept. 1965
INSULATORS:		
Production	4,845	4,350
Capacity	5,000	5,000
Capacity Utilization	97%	87%
CHEMICAL INDUSTRY MACHINERY & EQUIPMENT:		
Production	178	221
Capacity	350	350
Capacity Utilization	51%	63%
SPECIAL METALS & CERAMICS:		
Production	16	21
Capacity	25	25
Capacity Utilization	64%	85%
TOTAL:		
Production	5,039	4,592
Capacity	5,375	5,375
Capacity Utilization	94$	85%

NGK Insulators, Ltd.

MONTHLY PRODUCTION, CAPACITY & CAPACITY UTILIZATION
(Metric Tons)

	Six-Month Period Ending March, 1965	Six-Month Period Ending Sept. 1964
INSULATORS:		
Production	4,334	4,350
Capacity	5,000	5,000
Capacity Utilization	87%	87%
CHEMICAL INDUSTRY MACHINERY & EQUIPMENT:		
Production	256	269
Capacity	350	350
Capacity Utilization	73%	77%
SPECIAL METALS & CERAMICS:		
Production	23	22
Capacity	25	25
Capacity Utilization	92%	88%
TOTAL:		
Production	4,613	4,641
Capacity	5,375	5,375
Capacity Utilization	86%	86%

NGK Insulators, Ltd.

MONTHLY PRODUCTION, CAPACITY & CAPACITY UTILIZATION
(Metric Tons)

	Six-Month Period Ending March, 1964	Six-Month Period Ending Sept. 1963
INSULATORS:		
Production	4,221	4,103
Capacity	5,000	5,000
Capacity Utilization	85%	82%
CHEMICAL INDUSTRY MACHINERY & EQUIPMENT:		
Production	237	397
Capacity	350	490
Capacity Utilization	68%	81%
SPECIAL METALS & CERAMICS:		
Production	22	17
Capacity	25	20
Capacity Utilization	88%	85%
TOTAL:		
Production	4,500	4,517
Capacity	5,375	5,510
Capacity Utilization	84%	82%

NGK Insulators, Ltd.

MONTHLY PRODUCTION, CAPACITY & CAPACITY UTILIZATION
(Metric Tons)

	Six-Month Period Ending March, 1963	Six-Month Period Ending Sept. 1962
INSULATORS:		
Production	3,960	4,049
Capacity	5,000	5,000
Capacity Utilization	79%	81%
CHEMICAL INDUSTRY MACHINERY & EQUIPMENT:		
Production	348	407
Capacity	490	490
Capacity Utilization	71%	83%
SPECIAL METALS & CERAMICS:		
Production	13	10
Capacity	15	15
Capacity Utilization	87%	69%
TOTAL:		
Production	4,321	4,466
Capacity	5,505	5,505
Capacity Utilization	78%	81%

NGK Insulators, Ltd.

MONTHLY PRODUCTION, CAPACITY & CAPACITY UTILIZATION
(Metric Tons)

	Six-Month Period Ending March, 1962
INSULATORS:	
Production	3,836
Capacity	4,400
Capacity Utilization	87%
CHEMICAL INDUSTRY MACHINERY & EQUIPMENT:	
Production	385
Capacity	430
Capacity Utilization	90%
SPECIAL METALS & CERAMICS:	
Production	10
Capacity	15
Capacity Utilization	67%
TOTAL:	
Production	4,231
Capacity	4,845
Capacity Utilization	87%